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The Army Pollution Prevention Program: Improving Performance Through Benchmarking

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This report investigates the feasibility of using benchmarking as a method for improving Army pollution prevention. It defines benchmarking in its most basic terms, provides an overview of the benchmarking process, and illustrates its strengths and weaknesses by presenting three examples of benchmarking case studies. It also presents a comparative analysis of the Army prevention program in relation to 18 critical and essential elements of successful private industry programs. Lastly, it recommends a phased approach the Army could use to determine to what degree it should integrate benchmarking with other quality management tools to support the pollution prevention program, in light of present Army culture and mission area responsibilities.

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The Army Pollution Prevention Program:
Improving Performance Through Benchmarking

Executive Summary

The Army has begun to shift its environmental strategy from compliance and cleanup to pollution prevention, but the resources for this effort are limited. The question is whether the Army might avoid unnecessary expense by "benchmarking" to learn from, and measure itself against, other organizations that run similar programs effectively.

This approach is a widely used tool for continuously improving performance. An organization that wants to improve a process identifies other organizations known to be among the very best at doing it; compares its operation to theirs to see what they are (or are not) doing that makes them the best; focuses on how and why those processes work; and adapts their practices to its own process to improve performance.

Case studies of efforts in the public and private sector show that benchmarking can be of value in developing a state-of-the-art pollution prevention program:

- Several major corporations have already used the method to implement sweeping changes in their pollution prevention programs.
- One benchmarking study identified 18 essential characteristics for successful pollution prevention. These traits are immediately useful for assessing strengths and weaknesses in the Army's program.
- While the Army itself has not undertaken any formal benchmarking studies, it has probably used many of the underlying principles.

However, benchmarking is no cure-all, and the following cautions are important:

- Effective benchmarking requires complete understanding of the processes involved, substantial resource investment, and a strong management commitment to change.
- Undertaking formal benchmarking before the organization is ready can lead to disappointing results and a loss of focus.

- Organizations new to benchmarking should start with smaller projects deemed to have a high likelihood of success.

- Large organizations cannot benchmark the entire pollution prevention program. They should study only those components most amenable to benchmarking.

Recommendations

For these reasons we recommend that the Army be cautious in determining how benchmarking can or should be integrated with other quality management tools to support pollution prevention. A logical strategy would be to work in phases, initially to increase general awareness of the benchmarking process and its potential, and possibly even begin some small-scale benchmarking activities. Depending on the degree of success, the Army could then move forward with more ambitious projects, and ultimately establish a formal benchmarking program if desired.

We recommend the following phases and actions for such an approach.

Phase I — Establish Foundation

To facilitate the evaluation process,

- distribute this report at least to major commands, which could evaluate it for themselves and disseminate guidance to installations as appropriate;

- ensure that the existing prevention program is operating on the soundest possible footing. Track progress at all levels in complying with existing requirements as well as implementing the 18 critical and essential elements identified by private industry;

- encourage major commands and installations to apply basic benchmarking principles in day-to-day pollution prevention. Consider training selected personnel in the benchmarking process;

- pursue active membership in the International Benchmarking Clearinghouse and Global Environmental Management Initiative; and

- identify processes in the pollution prevention program that are most suitable for benchmarking, and prioritize them.

Phase II — Explore Process at Installation Level

Depending on the outcome of Phase I,

- provide formal training in benchmarking to selected pollution prevention staff in the Office of the Director of Environmental Programs;
- have that office conduct an internal installation-level benchmarking demonstration study that targets a specific process (e.g., hazardous waste disposal);
- announce the findings of the demonstration study; begin acting on them; and
- brief Army senior leadership on the results and implications.

Phase III — Explore Process at Major Commands and Above

Depending on the outcome of Phase II,

- encourage and support similar benchmarking initiatives among all installations;
- conduct a demonstration study between major commands;
- team with other DoD Component prevention program offices to study an area of mutual interest;
- participate in a pollution prevention benchmarking study sponsored by the International Benchmarking Clearinghouse involving private industry and/or other Federal agencies; and
- publicize results across the Army; brief senior leaders on the outcome and implications.

Phase IV — Implement Formal Benchmarking Program

Depending on the outcome of Phase III,

- establish a formal benchmarking program, with the pollution prevention division of the Office of the Director of Environmental Programs, or possibly the National Defense Center for Environmental Excellence, as the lead action office;
- publish detailed guidance on the program policies, procedures, goals, and objectives;

- closely monitor benchmarking program and overall results; and
- periodically review and assess the program to validate a continuing need for Army headquarters-level oversight, and if appropriate, delegate authority to major commands.

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CHAPTER 1

Background and Definition

BACKGROUND

The Army recognizes that prevention is clearly the best long-term solution for reducing risks to human health and the environment from pollution. This is well documented in the *U.S. Army Environmental Strategy Into the 21st Century,*[1] which incorporates prevention as one of its four pillars (the others are compliance, restoration, and conservation). The prevention pillar focuses on eliminating pollution as much as possible with integrated management approaches, procedures, and operations in all Army mission areas to minimize environmental harm.

As was the case with the private sector, the Army has learned that it cannot continue to rely solely on compliance-oriented techniques. After all, it is enormously expensive to provide end-of-pipe treatment and control of waste, or failing that, to undertake extensive restoration of contaminated sites. Compliance is, in fact, considered to be only the minimum acceptable level of performance. Organizations that desire to achieve higher levels of performance and avoid the odium of failure must be willing to reorient and take on new direction. In the Army's case, this means changing its institutional behavior from one of compliance and control to one of prevention.

The Army has already begun this transition with the formal establishment of its pollution prevention program.[2] It embodies the philosophy that pollution prevention, in concert with the conservation of natural and cultural resources, is the Army's preferred approach to managing the environment and complying with environmental laws and regulations. In this regard, pollution prevention will be used initially to complement, and eventually replace (where practical) the traditional pollution control and clean-up practices that currently predominate.

While the Army is headed in the right direction, it has a considerable distance to travel and limited resources with which to get there. It therefore makes sense to take advantage of the experience and lessons learned by similar organizations who have already made the journey. More importantly, perhaps, the Army should move quickly to identify processes and practices that have proven effective in (and possibly critical to) pollution prevention programs that clearly stand above the rest. This will not be an easy undertaking; however, tools are available that could help.

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[1] Army Environmental Policy Institute, 1992.

[2] Reference Headquarters, Department of the Army, Letter 200-94-1, subject: Army Pollution Prevention Program, 19 January 1994.

This report investigates the feasibility of using one such tool — benchmarking — as a method for improving Army pollution prevention. In this chapter, we define benchmarking and explain some of its main aspects. In Chapter 2, we illustrate its strengths and weaknesses with three examples of benchmarking studies. One of them identifies critical elements in pollution prevention that we use for a comparative analysis of the Army's program. We make recommendations for improving the Army program on the basis of that comparison.

Lastly, in Chapter 3, we recommend a phased approach the Army could use to determine to what degree it should integrate benchmarking with other quality management tools to support the pollution prevention program (in light of present Army culture and mission areas).

BENCHMARKING DEFINED

Definitions of benchmarking abound, but most include the same key elements. One source defines it as

> *. . . an external focus on internal activities, functions, or operations in order to achieve continuous improvement.* Starting from an analysis of existing activities and practices within the firm, the objective is to understand existing *processes*, or activities, and then to identify an external *point of reference*, or standard, by which that activity can be measured or judged. A benchmark can be established at any level of the organization, in any functional area. The ultimate goal is quite simple: to be better than the best — to attain a competitive edge.[3]

This definition provides a clear picture of what we are talking about, though it reflects an inclination toward competitive industry. This is not surprising, since benchmarking originated with large industrial organizations (principally Xerox). Its initial purpose in the United States was to bolster competition with the Japanese who had already mastered its application and were using it to great advantage in dominating large segments of the global marketplace.

But benchmarking is a useful tool for more than just competitive industry. It can be applied successfully to any organization, at any level. Consider the following definition from the American Productivity and Quality Center (AP&QC), which sponsors the International Benchmarking Clearinghouse:

> Benchmarking is the process of identifying, understanding, and adapting outstanding practices and processes from organizations anywhere in the world to help your organization improve its performance.[4]

This definition offers subtle differences that set it apart from others. First, it uses the word "outstanding" in lieu of "best," because what may be best for a specific organization will depend on its unique situation. It also stresses

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[3] C.J. McNair and Kathleen Leibfried, *Benchmarking: A Tool for Continuous Improvement,* Harper Collins Publishers, Inc., 1992, p. 1 and 2.

[4] Taken from an AP&QC advertisement (untitled and undated).

"adapting" outstanding practices to one's organization. This is important because benchmarking is much more than just metrics, competitive analysis, and directly imitating what others may be doing.

The AP&QC illustrates this by pointing to a hospital that improved its check-in practices by learning from a hotel chain, and an airline that greatly improved its maintenance programs by studying Indianapolis 500 pit crews. Although the respective organizations were dissimilar in function, one could adapt the processes the other employed to achieve world-class performance in a specific operational area. This offers strong evidence of the value and utility of benchmarking.

Benchmarking, then, is a tool for continuously improving organizational performance. It simply says if you want to get better at doing something, you should look at others who are among the very best at doing it. Then compare your operation to theirs to see what they are doing (or not doing) that makes them so good. ***The key is to focus on how and why processes work.*** Having determined that, adapt their practice to your own process or activity to improve performance. (Appendix A explains these steps in more detail.)

Private sector organizations generally tend to apply benchmarking to two main areas: *products and services*, such as the process for development of new products, and the types or degree of services provided to the customer; and *functions and processes*, such as hazardous material management or warehouse ordering procedures. Likewise, these organizations will usually benchmark against three distinct groups: their own internal operations, such as between departments or divisions; their top competitors, such as Ford versus General Motors; and any other organization that engages in similar or analogous operations or activities (as an example, a munitions manufacturer who wanted to reduce ammunition production times benchmarked against a lipstick manufacturer, because of the similarities between inserting lipstick into a tube and seating a bullet into its casing). These latter two types are called external benchmarking.

Benchmarking against *internal* operations involves identifying the best performers within a multiunit organization and applying or adapting their practices to other units. In the Army's case, this might involve looking collectively at the major commands (MACOMs) or installations as types of units. *External* benchmarking looks outside one's own organization. For the Army, this would most logically include the other DoD Components, but it could realistically include any other organization having similar operations or activities (e.g., the Department of Energy, Martin Marietta); benchmarking practitioners have found that an organization identifies more innovative solutions when it looks outside of its particular industry.

The next chapter gauges the usefulness of benchmarking, both in general and as it may be relevant to the Army. We summarize three examples of benchmarking (details are provided in appendices). One of the studies identifies critical elements in pollution prevention that we use for a comparative analysis of the Army's program.

CHAPTER 2

Assessing the Benchmarking Technique

WHY BENCHMARK?

Current literature provides much insight into benchmarking's potential benefits. Jerry Balm, a senior quality consultant with IBM, sees two reasons why an organization that is trying to improve itself should benchmark:

> One is to help set goals toward becoming best at what you do, at all things that you do. Without benchmarking you don't know what that is. Secondly, you augment the good ideas that normally roll in from your own employees, with some creative and innovative ideas from other world-class companies, to get the best-of-the-best efficient and effective ways to make yourself best as well.[1]

Similarly, some of the potential benefits identified by Xerox[2] include the fact that benchmarking can help to

- ensure that best practices will be identified and improvement targets set,
- overcome disbelief about practices and convince companies that they can improve on them,
- counter reluctance to try something different,
- identify new technologies that may be used in other industries, and
- redirect companies from having only an internal focus to look outward toward the marketplace.

In addition to IBM and Xerox, corporations such as AT&T, Motorola, 3M, Intel, and Westinghouse have found the process especially useful and have completed numerous benchmarking studies. 3M, AT&T, and Intel, in particular, have used benchmarking to implement sweeping changes to their pollution prevention programs, with marked results.[3]

As with most new concepts, benchmarking is easier to understand and evaluate with specific examples. The Army does not appear to have undertaken any formal benchmarking studies to date, although some agencies, such as the

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[1] Harmon, Marion, "Benchmarking," *Quality Digest*, 12:20 – 31, July 1992.
[2] Tomas, Sam, "Stealing Shamelessly," *APICS A&D SIG Digest*, 6:23 – 25, April 1992.
[3] Danback, Barry, AT&T, phone conversation, January 1995; McManus, Terry, Intel.

Army Materiel Command (AMC) Management Engineering Activity, have become active members of the International Benchmarking Clearinghouse. In this regard, the Army has been involved in benchmarking only as a general spectator.

On the other hand, the Army has likely employed (and will continue to employ) many of benchmarking's underlying principles on a day-to-day basis. Consider, for example, the action officer on the Army Staff who has received a tasking to develop an improved Army-wide procedure for managing hazardous materials. Rather than "reinvent the wheel," a common approach to the task would be to determine whether or not any of the other Components had developed similar procedures with success. If so, those procedures might be reviewed to determine if they could either be used directly or adapted (perhaps even improved upon) to fit the Army's requirement.

As another example, consider a study recently undertaken by the Army to improve its implementation of the National Environmental Policy Act (NEPA) process. During the early investigative phase of the study, key staff from both the Enviornmental Protection Agency (EPA) and the Council on Environmental Quality (CEQ) were interviewed and asked to outline what they felt the Army should do to improve its NEPA compliance track record. Their response was that the NEPA programs with the best overall performance records (i.e., best-in-class) belonged to the Air Force and Fish and Wildlife Service and that the Army should look closely at them for the answer. Subsequent evaluations of those programs identified several organizational and procedural differences that enabled them to perform more effectively (i.e., performance enablers). The Army is now preparing to adopt similar practices that will enable it to improve its overall performance to comparable levels.

We have drawn three case studies from the operational experiences of organizations outside the Army. These examples help to show what benchmarking means, how it is used, and what its strengths and limits are. This chapter summarizes studies done by Eastman Kodak and the Department of Energy (DOE), and then looks in more detail at pollution prevention benchmarking by the Business Roundtable. The selected studies illustrate both generalized and focused approaches to the benchmarking process.

EASTMAN KODAK: "KODAK CLASS" MAINTENANCE

This focused study was undertaken by Eastman Kodak in an effort to improve its worldwide general engineering and maintenance support services. The specific areas targeted for improvement were the amount of reactive (unscheduled) maintenance work being performed, and overall maintenance costs as a percentage of manufacturing costs. The study (detailed in Appendix B) applies all of the traditional benchmarking steps (to include identifying and comparing process variables and metrics) in order to identify specific enablers[4] for improvement of the targeted internal processes.

In addition to exemplifying a focused study, it simultaneously illustrates both internal and external benchmarking. Furthermore, it shows how benchmarking can be conducted within a multinational organizational environment. Beyond that, its principal objective — reducing the total amount of organizational maintenance work and associated costs — is a primary concern of the Army's logistics community; hence, the results obtained have a valuable practical application for the Army. The study also has merit from a pollution prevention perspective because reducing an organization's maintenance workload helps to minimize hazardous waste generation and disposal.

The study offers a great deal of insight into benchmarking. Key among its teachings are that management support and involvement is critical throughout the entire benchmarking process, as is participant accountability. Lastly, it emphasizes that to be most effective, benchmarking should be fully integrated with the organization's strategic planning process.

These points are reinforced through the next case study, which highlights the Department of Energy's initial experience with benchmarking.

DEPARTMENT OF ENERGY: COST IMPROVEMENT

This benchmarking effort (detailed in Appendix C) targeted a key area of interest to the Army and its pollution prevention program — the monitoring of hazardous material storage tanks associated with environmental restoration projects and waste management activities. The specific process chosen for benchmarking was tank storage of hazardous materials in quantities ranging from 1,000 to 25,000 gallons of liquid, sludge, or slurry waste. The overall goal was to identify practices that could lead to cost improvement. To facilitate the study, a benchmarking partner (unidentified) with an analogous process was selected for data comparisons.

The study resulted in the identification of many enablers (in this case, management practices) that can lower overall program costs. The enablers related either directly to tank monitoring, or to supporting operations. DOE concluded that many of these managerial practices could be adapted and applied to its program.

For the Army, however, the most important teaching point (to be considered while evaluating benchmarking) is that undertaking benchmarking studies before the organization is totally ready can lead to disappointing results and a loss of focus. In this example, DOE environmental managers discovered after concluding the study that there were other higher-priority, programmatic issues that

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[4] Enablers are those practices, methods, or processes that allow (enable) a best-in-class organization to develop and maintain best practices.

needed to be addressed before they could effectively pursue the benchmarking study's findings and recommendations. As a result, the study (which later won an award for its overall design and execution) has essentially been "put on the back burner," with no follow-up action being taken or projected for the near future. Hopefully, the results of the DOE effort will not otherwise be overcome by events before they are implemented, but in a worst-case scenario, this could become the end result.

Business Roundtable: Facility-Level Pollution Prevention

This generalized study sought to answer a rather basic but very important question — "What are the common or unique elements of successful pollution prevention programs?" The study was conducted by the Business Roundtable, an association of business executives who investigate public issues that impact the economy. It examined six best-in-class companies in order to identify common practices. As a methodology, the first six steps of the widely used AT&T benchmarking process were followed.

The ultimate result of the study (detailed in Appendix D) was a listing of 18 critical and essential elements of successful programs, with no specific reference to metrics or qualitative considerations. This information was then provided to all participants, who were free to determine whether and how the results could best be used to improve the performance of their own programs.

The Business Roundtable study is unique in that it does not focus on a specific, clearly defined process with the intent of identifying objective enablers for process improvement. For example, it does not address a process — such as hazardous material management — with the goal of identifying those enablers that could help an organization reduce hazardous material acquisition costs. Rather, it seeks to identify the common or unique elements of successful prevention programs from a broader perspective.

The value of this type of study is that virtually any like organization can apply it (at any level) to assess its pollution prevention program. The Army, for instance, can use it to determine whether it has established at least the proper institutional framework to support best-in-class performance, by comparing the 18 identified critical and essential elements with the existing elements of the Army's program.

In the following section, we present such an assessment, both for what it illustrates methodologically about the utility of benchmarking, and for what it reveals substantively about the state of the Army pollution prevention program.

Assessment of Army Effort Using 18 Critical and Essential Program Elements

The Business Roundtable study affords the opportunity to compare key elements of the Army prevention program to the critical and essential elements of the best-in-class private industry programs. One can then highlight areas where significant shortfalls appear, identify the likely causes of those shortfalls, and make appropriate recommendations for improvement.

However, it is important to note that the Roundtable study does not provide performance variables or metrics for objectively judging whether an organization has implemented the essential elements to a satisfactory degree. For example, while one can say without question that the Army has established pollution prevention goals, there are no specific benchmarks to determine whether those goals are in fact good or bad. It can only be stated with certainty that they do or do not exist. Also, the study does not identify the enabling mechanisms that allow these companies to maintain the best practices. To identify them, a more comprehensive and focused benchmarking study is necessary.

In view of this, any recommendations in our assessment are purely subjective, based solely upon the authors' corporate experience and best professional engineering and management judgment.

We describe each of the critical and essential elements along with the benchmarking team's findings,[5] briefly assess the Army's current program in relation to the element, and make recommendations[6] for improvement, where appropriate.

For the convenience of the reader, Table 2-1 and Figure 2-1 summarize the overall results of the assessment. The elements generally fall into two categories: actions and attributes. Actions are evaluated according to the degree of their implementation within the Army's program. Attributes are assessed according to the level to which they have been attained. We have assigned ratings based solely on the information currently available; no further analysis has been conducted.

ELEMENT 1: A CLEAR UNDERSTANDING OF POLLUTION PREVENTION DIRECTION AT ALL LEVELS

This element focuses on having a definition of pollution prevention that all levels readily understand, as well as clearly defined pollution prevention mission, vision, or policy statements. At a minimum, all six companies that were benchmarked included source reduction and recycling/reuse in their program definitions of pollution prevention. However, none relied solely on source reduction to achieve their goals. Some, such as Procter & Gamble and Monsanto,

[5] Information in the discussion section for each element is taken directly from the *Business Roundtable* report with little modification.

[6] Recommendations are highlighted by bold-faced italic text.

Table 2-1.
Army Pollution Prevention Program Status Summary

Critical elements	Not implemented	Minimal implement-ation	Moderate implement-ation	Nearly complete implementation	Fully imple-mented
1. Facilities had a clear understanding of pollution prevention direction.		X			
2. Facilities identified wastes and emissions.			X		
3. Facilities had pollution prevention goals.		X			
4. Facilities used a champion, facilitator, or other focal point to lead program.		X			
5. Management supported pollution prevention.		X			
6. Pollution prevention was integrated into business planning.			X		
7. Priorities were assigned to waste streams.			X		
8. Cross functional teams were used.		X			
9. Sustainable pollution prevention programs were cost effective.	X				
10. Pollution prevention programs were tracked and communicated.				X	
11. Facilities used quality tools in their pollution prevention program.				X	
12. There was responsibility and accountability for pollution prevention results.			X		

Table 2-1.
Army Pollution Prevention Program Status Summary (Continued)

Critical elements	Not implemented	Minimal implement-ation	Moderate implement-ation	Nearly complete implementation	Fully imple-mented
13. Facility pollution prevention teams knew their plant culture and patterned their program to that culture.			X		
14. Recognition sustained employee motivation.					X
15. Company resources supported facility pollution prevention programs.			X		
16. Pollution prevention was integrated into premanufacturing decisions or choices.					X
17. Facilities used new technology to achieve significant improvements.			X		
18. Effective communication increased pollution prevention awareness.				X	

included the entire waste management hierarchy in their definition (i.e., source reduction, recycling, recovery [reuse], treatment, and disposal). Martin Marietta took a similar approach by simply defining prevention as any activity that reduces the company's impact on the environment. Others, such as Du Pont, use the waste hierarchy excluding treatment and disposal.

From the policy perspective, all companies had a corporate environmental policy addressing or including prevention, and facilities either had a corresponding policy in place, or had pledged to fully embrace the corporate policy. An interesting point observed at Intel was that while both corporate and facility policies existed, the facility policies were the real driving forces behind the program.

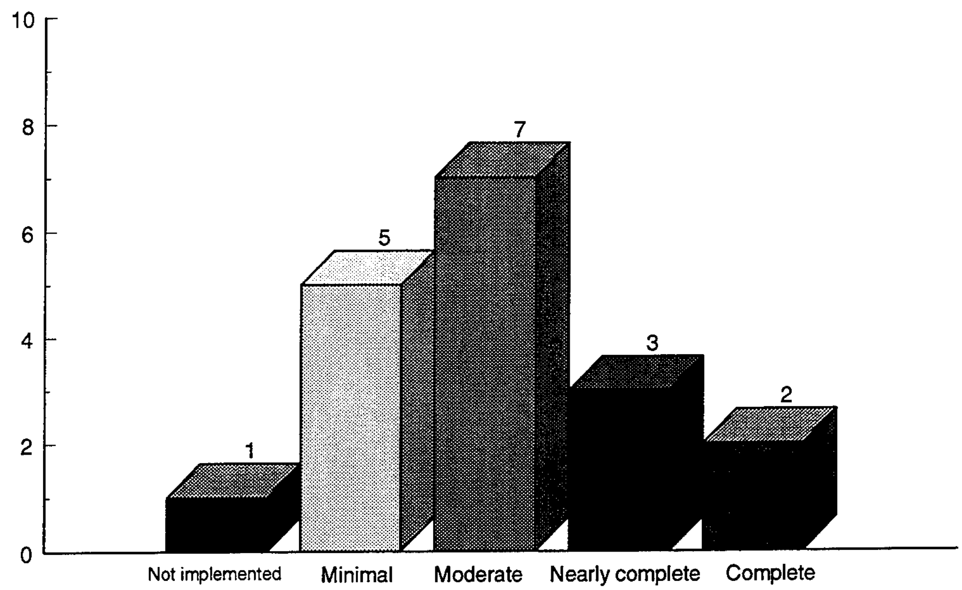

Figure 2-1.
Army Implementation Status of Critical and Essential Elements

Army Program Element

Generally speaking, the Army defines pollution prevention as "any reasonable mechanism to successfully avoid, prevent, or reduce pollutant discharges or emissions other than by the traditional method of treating pollution at the discharge end of a pipe or stack . . . Prevention focuses primarily on methods that do not depend on treating or controlling existing waste/release streams to reduce or eliminate hazardous or other polluting inputs to the environment . . . Prevention includes modifying manufacturing processes, maintenance, or other industrial practices; modifying product designs; recycling; preventing the disposal and transfer or pollution between media; increasing energy efficiency and materials conservation; promoting land and ecosystem conservation practices; and all necessary training promoting use of non-toxic substances . . . Even with the primary focus on source reduction, pollution prevention can be implemented at any stage of the pollution management hierarchy: input; use or generation; and treatment."[7]

Army pollution prevention policy states that "pollution prevention . . . is the Army's preferred approach to environmental management and maintaining compliance with environmental laws and regulations."[8] The Army also incorporates prevention as a key pillar of its long-term environmental program strategy, which outlines — as an integral part of its mission — its vision to be a national leader in environmental and natural resource stewardship for present and future

[7] HQDA Letter 200-94-1, DAIM-ED-P2, Army Pollution Prevention Program, 19 January 1994.

[8] Ibid.

generations. All MACOMs and installations must develop and implement detailed pollution prevention plans in support of this policy and direction. AMC has a prevention plan with goals and a policy statement, and the National Guard Bureau is finalizing a prevention regulation. Beyond this, however, formal policy statements are generally lacking at both levels. This leaves a major gap between Headquarters, Department of the Army (HQDA) and the installations.

Assessment and Recommendations

The Army's definition of pollution prevention aligns well with those of the benchmarked companies, clearly stating that prevention starts with a primary focus on source reduction. This is also consistent with general statutory and regulatory guidance on this subject, although technically, it deviates from the EPA's official definition by not focusing entirely on source reduction and in-process recycling.

While we consider the Army's definition a good one, just having it does not guarantee understanding. To the contrary, a relatively small percentage of the Army community understands what prevention really means (this is partly due to the newness of the program, as well as to subtle differences among definitions by the CEQ, EPA, DoD, and Army). An example of this lack of understanding is reflected in RCS 1383 project submissions, in which the pollution prevention category appears to have become a catchall for almost anything environmental.

Most people in the Army associate prevention almost exclusively with hazardous waste minimization (HAZMIN), overlooking other key elements such as changing behavior and modifying processes. This is particularly acute at higher levels of management, where emphasis is still strongly leaning toward restoration and compliance. ***The best way to address this apparent shortcoming is through increased communication and awareness programs.*** This process is already under way to a certain extent through pending revisions of 1383 guidance and AR 200-1, *Environmental Protection and Enhancement*, which will better communicate the DoD's and Army's definitions of prevention.

The Army's pollution prevention policy represents a bold departure from the past — a major shift in corporate philosophy. While this change in direction strengthens the program, it should also be approached carefully. It essentially requires a change in behavior across the entire Army from one of control and compliance to one of prevention. Making such a transition will not be easy, and there is likely to be considerable inertia, particularly at the installation level. After all, as Intel points out, facility (installation) policies are the real driving force behind prevention efforts. This comes as no surprise, since prevention unquestionably occurs at the installation level, where the rubber meets the road.

In consideration of this, the Army must ensure that all activities down to and including the installation level fully understand and support the spirit of the policy. An appropriate mechanism for this would be the review and approval of all major command and installation pollution prevention plans. This

is currently an HQDA requirement tasked to the Office of the Director of Environmental Programs (ODEP). Including this issue as an Inspector General area of interest during annual general inspections would provide extra emphasis. Furthermore, the Army may wish to comprehensively review cross-cutting regulations (e.g., logistics, training, acquisition, procurement, base operations) to ensure that they appropriately reflect Army pollution prevention policy.

While the Army's policy statement is forceful and clear, the Army must understand that it cannot expect installations to make the transition it demands unless they have the means to do so (and examples at higher headquarters). As will be seen later in this section, therein lies the real challenge to effective implementation.

Element 2: A Method to Identify Wastes and Emissions

All of the companies surveyed identified and tracked both hazardous and nonhazardous waste streams. It is important to note; however, that waste tracking did not always include waste measurement. Each company used personal computer (PC)-based systems to track waste streams, and were able to customize off-the-shelf spreadsheet software to their requirements.

3M used a profile system to identify each waste stream its facilities generated. However, the company did not measure each waste stream.

Du Pont assigned responsibility for waste stream management to each facility area and required them to make data entries directly into the system. This included completing waste characterization forms for each waste. The environmental group then tracked total waste streams through the PC system. Procter & Gamble tracked solid waste back to individual operating areas. It tracked air emissions by individual source, and wastewater by total discharge quantity and individual operating areas.

The key considerations here are having a sound tracking system, being able to track all pertinent waste streams, and ensuring that tracking conforms with required or planned uses of the data.

Army Program Element

This is a key area where the Army's program performance has been sporadic. In conjunction with its major effort to reduce hazardous waste generation by 50 percent by 1992 (1985 baseline), the Army began closely tracking hazardous waste from generation to disposal down to the installation level. This has been done primarily through the Defense Reutilization and Marketing Service, which serves as the Army's principal hazardous waste disposal agent. Generally speaking, installations track this disposal by Resource Conservation and Recovery Act category in order to comply with its requirements. Unfortunately, these categories tend to be too vague for pollution prevention purposes.

Technically, the Army has done a better job of budgeting for waste disposal than tracking waste streams. The RCS 1383 data base effectively captures budget requests, but it cannot document the results of their application to the waste recycling and disposal effort. The principal Army data base for waste tracking has been (perhaps by default) the Army Compliance Tracking System (ACTS). The system's capabilities are limited, however, and ODEP estimates that it captures perhaps only 10 percent of the total waste stream. This primarily includes gross quantities of hazardous waste disposed, as well as some limited recycling data (hazardous and nonhazardous waste). Solid waste disposal, air emissions, domestic and industrial wastewater, and energy use are not currently tracked at all.

The Army has also made several fragmented attempts to track waste by specific media program areas. An example is its 1992 comprehensive program to assess air emissions. Pollutant summaries from this effort will eventually be consolidated into a data base, which will then be used for annual tracking purposes. More recently, a Pollution Prevention Opportunity Assessment (PPOA) program has also been instituted Army-wide. Under this program, each installation will receive an in-depth, multimedia analysis of operations, activities, processes, and associated waste streams. In addition to facilitating specific waste stream identification, the program will help installations identify opportunities for implementation of pollution prevention techniques or technologies.

Recent executive orders mandating compliance with the Emergency Planning and Community Right-to-Know Act (EPCRA) and Toxic Release Inventory (TRI) reporting requirements are also helping to move the Army toward prevention and will force more comprehensive identification and tracking of wastes. Additionally, Army initiatives (as part of the Defense Environmental Security Corporate Information Management [DESCIM] effort) to field a new hazardous substance management system will greatly enhance the Army's capabilities in this key area.

Assessment and Recommendations

Clearly the Army has some catch-up work to do in this area. If the Army's new direction is to prevent rather than control and clean up, it must have effective program management tools. This includes knowledge of wastes and waste streams detailed enough to facilitate strategic planning and policy development, and to measure progress toward program goals and objectives. ***Appropriate tracking systems should be established (or in the case of ACTS, upgraded) in conjunction with forthcoming Army efforts to implement EPCRA and TRI reporting. At a minimum, tracking capabilities should include hazardous material procurement and associated waste disposal (this is being addressed through DESCIM efforts to field the new management system), multimedia waste stream analysis, solid waste disposal, air and water emissions, and energy consumption.***

Element 3: Pollution Prevention Goals in Place

All participating companies had corporate and/or facility-level pollution prevention goals. Generally, goals incorporated input from all personnel down to the plant level. This was accomplished by ensuring that their ideas passed through environmental leadership channels for consideration. Where appropriate, the public (or at least public perception) may play a part in goal development. In many cases, goals signaled that pollution prevention was a "core value" of the company, and this served to help strengthen and facilitate implementation of the prevention program across the organization.

For the most part, corporate goals were set to provide general direction only. While facilities were free to set their own goals, corporate goals represented the minimum standard. Facilities often set strategies by operating area, and each area then identified ways to support the strategy. Principles behind the goals varied, but most focused on reducing waste generation, employee exposures, chemical and energy usage, and the like.

Another key consideration in setting goals is that they must be realistic, achievable, and measurable. This is necessary to enable the organization to determine the success of the program. The benchmarked organizations each measured success differently, although in general they looked at such things as cost reductions, reduced volumes or toxicity, reduced exposures, improved public image, or results against goals.

Army Program Element

Management goals for the Army prevention program are developed at the HQDA level in close coordination with counterpart organizations at DoD, and are found in several different source documents. These include the prevention portion of the environmental strategy document, its corresponding action plan (known as an Army strategic action plan), the HQDA policy memorandum for the prevention program, and to a lesser degree AR 200-1.

Major program management goals are to develop and sustain a fully integrated Army pollution prevention program; to fully comply with Executive Orders 12856 (Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements) and 12873 (Federal Acquisition, Recycling, and Waste Prevention); to systematically reduce or eliminate pollution at the source; to foster pollution prevention partnerships; and to instill the pollution prevention ethic across the total Army. The strategic action plan further buttresses these goals in the specific categories of installation/facility pollution prevention; installation solid waste reduction; energy efficiency; weapon system management and logistical support; military operations and training; medical services; acquisition pollution prevention; and research, development, test, and evaluation (RDT&E). Each of these categories carries more specific associated goals, required actions, and performance indicators.

While the Army's goals are well-documented, they apparently lack one critical element — developmental input from the major commands and installations that will ultimately have to achieve them. Developing goals and associated directives with no field input sets a stage for almost certain conflict and backlash at the operational level.

Although goals have been established and directives issued, the general feeling at HQDA is that they (primarily the directives) are not strongly followed in the field. In conjunction with this, few pollution prevention goals have been established at the MACOM or installation levels. (AMC is the only major command to have formally set prevention goals, but the development of the MACOM/installation pollution prevention plan now under way will address this deficiency.) ***As mentioned earlier, HQDA should pay particular attention to these goals for conformity during the formal review process.***

Fortunately, this situation has not hurt the overall performance of the program. In fact, some installations (that are not necessarily following Army policy at all and have not set goals) are winning awards at the state level for their innovative programs. For example, several installations have implemented PC-based hazardous material management systems, although Army policy prohibits such action before fielding of the forthcoming DoD-wide system. Letterkenny Army Depot expanded its recycling program by accepting waste from surrounding civilian communities (also a violation of Army policy), creating an image-enhancing partnership that has netted over $500,000 in profits as well as accolades from the Governor of Pennsylvania.

In these instances, installation commanders are weighing policy and directives against what they believe must be done to best accomplish the prevention program mission. This situation is reminiscent of the old Model Installation Program, which has since become part of the Army Ideas for Excellence Program.

Under the Model Installation Program, installation commanders were afforded the opportunity to manage creatively, test innovative ideas, eliminate regulatory impediments, and generally challenge traditional Army systems and management techniques. ***The Army should consider reinstituting the Model Installation Program specifically for pollution prevention. (This might be expanded to include a "model acquisition" program, since this is a key area of focus for long-term waste reduction.)*** This is already happening at the DoD level, and it is interesting to note that Corpus Christi Army Depot has been designated the DoD model installation for implementation of the depot maintenance-hazardous material management system. This system is in use at many installations operating under the "pharmacy" concept[9] for hazardous materials management, a key pollution prevention initiative.

[9] Under this concept, hazardous materials are intensively managed, controlled, and dispersed — in much the same manner that prescription drugs are dispensed at a typical hospital pharmacy.

In addition, the Army should provide for field participation (both major commands and installations) during future development of program goals and objectives. This could be accomplished by formally soliciting input at the appropriate time to ensure its full consideration, and/or by circulating proposed goals and objectives for comment prior to finalizing them.

ELEMENT 4: A CHAMPION, FACILITATOR, OR OTHER FOCAL POINT

In each company benchmarked, a facilitator "championed" the pollution prevention program. The facilitator worked with prevention program and cross-functional teams. Facilitators were not necessarily physically located at facilities but ensured that pollution prevention achievements were fully communicated to all personnel. They also worked with a primary goal of raising the pollution prevention awareness of all personnel. Actual job titles for the designated facilitators included environmental engineering supervisor, waste management team leader, senior environmental engineer, director of environmental management, supervisor of environmental technology, and environmental department manager. These titles illustrate that the facilitators ranged over a rather broad spectrum, from the team leader to department manager level.

Army Program Element

The Army is devoting substantial personnel resources to the daily management of its prevention program. In addition, senior managers are being effectively used at the HQDA level to provide needed visibility to the program. Principal champions include the Director/Deputy Director of Environmental Programs and key members of the pollution prevention division. In the latter case, the division chief champions prevention in R&D, while another staff member champions recycling. The Army Environmental Center also plays a key role by championing prevention in the industrial arena. As a boost to these efforts, periodic higher level players are becoming involved. For example, the Army Chief of Staff made a strong push for pollution prevention during a November 1993 address to the Senior Environmental Leadership Conference. In part, GEN Sullivan said:

> Now to address pollution prevention, I think we must make the investment to halt the expense of future cleanups. We've got to make the investment. The dollars committed to the environmental program are going up. . . It just takes your breath away. Every installation must prepare a pollution prevention plan. We have to reduce hazardous waste by 50 percent by the end of the decade. The president has said that. We have to get on with it.

Comments of this nature made in public forums go a long way to bolster general support for and command involvement in new or emerging programs.

As with many other aspects of the prevention program, the existence of similar champions below the HQDA level is not so evident. Some installations and activities do have champions [primarily Training and Doctrine Command

(Army) and Forces Command installations that have large military populations], but the majority do not. This is primarily due to the fact that championing competes with other assigned duties, and most personnel cannot afford the luxury of focusing almost exclusively on one program area. As a result, championing becomes a shared responsibility and suffers accordingly. This is particularly acute at industrial installations where personnel are usually too busy reacting to day-to-day crises.

Assessment and Recommendations

The Army is doing a fairly good job of championing at the higher echelons and needs to keep the momentum going. ***The Army leadership must continue to affirm support for pollution prevention by making remarks in public forums and by endorsing (if instituted) the aforementioned model installation pollution prevention programs. In addition, senior leaders and staff must get more involved at lower echelons. The obvious starting points include the command channels and the environmental staffs.***

It is well known in Army culture that those areas of primary interest to the commander tend to receive the most attention from personnel at all levels. ***To ensure success, the pollution prevention program must become an item of increasing command interest, and all commanders must become champions. In addition, environmental program management staffs at both the command and installation levels should designate champions to spearhead their activities. This must include providing time and resources to ensure proper emphasis. Lastly, all Army personnel, active and reserve, military and civilian, must understand that they too have an individual responsibility for pollution prevention throughout their daily operations and activities.***

ELEMENT 5: FULL SUPPORT OF MANAGEMENT

This primarily relates to the fact that corporate management recognized the importance of pollution prevention and committed the resources needed to support program activities. Management commitment was one of the key elements common to all six corporate prevention programs. This commitment included providing requisite time and resources to get the job done. Where appropriate, it also included managers' personal participation at some level to ultimately ensure the success of the program.

Army Program Element

Environmental program staffs and most commanders voice general support for the pollution prevention program. Despite this increased emphasis, the Army is not funding its prevention program at effective levels. For example, in FY95, the Army has budgeted approximately $608 million for environmental compliance, but only $59 million for prevention. Of that amount, $32 million is targeted for ozone-depleting compound elimination, which is essentially a compliance requirement. This means that prevention is receiving only a token share of available environmental funding.

Ironically, this situation has resulted in part from the current Army environmental "must-fund" policy and its associated RCS 1383 reporting system. By the time all must-fund environmental projects and other mission-essential requirements have been funded, the typical installation has few resources left for the heretofore lower-priority prevention projects that "go beyond compliance." This is particularly acute at installations operating under the Defense Business Operating Fund, which must include capital and operating costs for such projects in the rates it charges its customers for services. Capital investments in pollution prevention equipment and process changes tend to inflate these rates, making them less competitive. This may, in turn, reduce the incentive for large investment in process improvement.

In addition, there is little help available from other likely funding sources such as RDT&E or acquisition. The Army essentially has no technical base (6.2/6.3) funding in pollution prevention, and obvious disincentives exist in systems acquisition to fund pollution prevention R&D. Program managers are concerned with developing and fielding new weapons systems, which is, after all, their primary mission. Given the limited resources available, they realistically cannot address prevention issues much beyond their application to the specific systems under development. They are simply not in a position to look at prevention from a total Army perspective.

The Army recognizes that this situation is not consistent with Army and national policy to increase emphasis on pollution prevention while decreasing emphasis on pollution control. In light of this, it has begun work on two major initiatives. The first is a pollution prevention investment fund, which will provide installation commanders a source of funding for prevention projects that is separate from the compliance pool. The second is an investment forecasting tool known as the Pollution Abatement and Prevention Analysis (or PAPA) model, which will help ensure that funding is applied toward those projects that offer the greatest environmental benefit and return on investment.

Assessment and Recommendations

The Army is deficient on this issue, but the outlook is promising if the two initiatives under way are completed. ***The Army must establish the investment fund (or comparable account) without further delay to ensure that commanders have the resources to achieve program goals and objectives. The projected implementation date of FY97 is a realistic goal that should be met. The PAPA model should also be fielded, down to installation level. The challenge will be to make it user-friendly enough so that a commander can quickly decide which prevention projects should be funded.***

The Army also should consider revising its must-fund policy. Although the policy has greatly improved the Army's overall image and compliance posture, it is causing concern among commanders who must try to address ever-increasing requirements with ever-decreasing resources. They believe that the policy is too restrictive, and that there is a need for a new policy based on forward-looking environmental stewardship, flexibility, and achieving maximum return on investment.

Lastly, the Army should negotiate with regulators for delayed enforcement to allow a gradual transition to prevention, given available funding. For example, it might reach selective agreements to have fines and penalties suspended for an agreed period in specific cases where prevention remedies will eventually replace control remedies.

Element 6: Pollution Prevention Integrated into Business Planning

The key points of this element are that companies integrated environmental considerations into business case analysis, included pollution prevention in the business planning process, and when possible used pollution prevention proactively in anticipation of compliance requirements. A primary concern was to identify business barriers to prevention and mechanisms to overcome them.

Actual implementation of these concepts varied from one company to another. For example, Procter & Gamble employees assessed business plans to identify how pollution prevention projects could help accomplish established goals. At Martin Marietta, the capital and overhead budgets of the business planning process specifically incorporated pollution prevention program goals. At Monsanto, pollution prevention was an integral part of its five-year plan for facility management. Overall, the companies tried to project compliance requirements by three years, with the idea that pollution prevention would play a major role in addressing those requirements.

Army Program Element

The Army program recognizes the need to be more proactive in this area and efforts are under way to become so. Forthcoming updates to regulations intend to shift waste reduction programs from the predominant hazardous waste minimization toward new thrusts associated with the Pollution Prevention Act, EPCRA, and Executive Order 12856.

Army policy mandates the integration of pollution prevention into all planning, operational processes, and activities. This specifically includes all life-cycle phases in the acquisition of new weapons systems, the management and logistical support of fielded systems, development of specifications and standards, material management, military operations and training, doctrinal development, supply and logistical activities, infrastructure life cycle, base operations, installation support activities, health and medical activities, contingency operations, RDT&E, industrial operations, and energy programs.

Pollution prevention principles and technologies are being integrated throughout the life cycle of weapon systems to improve material management practices, to minimize the quantities and types of hazardous materials at Army installations, and to promote the use of recycled products. The Army Acquisition Pollution Prevention Support Office (AAPPSO) is supporting the Army acquisition executive, procurement executive officers, and acquisition program managers to ensure that this happens. Pollution prevention guidelines have recently been incorporated into Base Realignment and Closure procedures. Additionally, a detailed review of specifications and standards is under way to incorporate substitutions that will minimize requirements for hazardous and toxic substances. Beyond these limited efforts, however, the reality has been that the broad policy objective is not being met. The only notable exception appears to be when NEPA compliance requirements catch commanders by surprise.

Addressing future compliance requirements proactively through prevention is an area where Army behavior is beginning to change, although slowly. Where there are obvious opportunities, the Army has been responsive. Ongoing efforts to revise specifications and standards offer a good example.

Assessment and Recommendations

It is clear that much work still needs to be done here. Pollution prevention plans under development at MACOMs and installations, and continued focus by the chain of command, should help to improve overall performance in this area. The aforementioned recommendation to review cross-cutting regulations would also help ensure that prevention is appropriately integrated into business planning.

Another approach that could be used effectively to provide additional emphasis is through NEPA compliance channels. NEPA documentation represents the Army's primary environmental planning vehicle, and the ultimate goal of that process is, after all, to prevent environmental degradation (to prevent pollution, although not entirely in the source reduction sense). The idea here would be to force integration early during the program development process, (i.e., while building the program objective memorandum.)

To accomplish this, an environmental specialist in the Office of Program Analysis and Evaluation would review all program proposals to see that they properly integrate environmental considerations, especially prevention. Proposals that do not would be returned without action. In other words, they would not even be considered for funding unless they properly addressed environmental considerations.

To facilitate the use of prevention to address future compliance requirements, the Army should consider modifying its RCS 1383 project submission

procedures. This would entail adding new data fields for commanders to certify that they considered pollution prevention alternatives for each compliance project, and to enter the specific reasons a prevention project could not be implemented instead.

For example, if a submitted project calls for installing an environmental control device in a waste stream, the justification for not implementing a prevention project (to eliminate the waste stream or its hazardous components) might include such things as the nonexistence of requisite technology, or the fact that the cost of doing so would far outweigh any environmental benefit. This information would then be considered when choosing projects to fund.

Element 7: Priorities Assigned to Waste Streams

While none of the companies had established a formal, rigorous process for prioritizing waste streams (or prevention projects), they all did use some type of informal criteria-based system. The type and consistency of actual criteria varied. For example, 3M prioritized based on waste quantity, degree of toxicity, relative hazard potential, customer requirements, and the overall probability of success. At Du Pont, facilities primarily looked at waste volumes and completed Pareto analyses of elements such as waste streams and waste-generating areas of plants. The largest waste stream identified then became the focal point.

Martin Marietta concentrated on regulatory requirements, waste volume, toxicity, success potential, disposal costs, land-ban mandates, operational impacts, and future liabilities. Monsanto considered environmental, health, and safety impacts, ease of waste reduction, waste placement within the hierarchy (e.g., first priority to source reduction), expected return on investment or payback, and consistency with long-term goals. Procter & Gamble facilities applied consistent criteria to solid waste targets and prioritized by calculating the product of waste volume and disposal cost. Air and water waste streams were prioritized by relative environmental impacts and/or future regulatory requirements.

Regardless of the criteria and prioritization method, the key is to apply them consistently and in concert with the organization's long-term program goals and objectives.

Army Program Element

The Army outlines the recommended approach for prioritizing waste streams in its installation guidebook for developing pollution prevention plans. The approach recognizes that most installations have numerous operations and activities, each of which may have many processes and resulting waste streams. It stresses the need to base priorities on hard data analysis and overall program goals and objectives.

The guidebook identifies critical factors for targeting and prioritizing waste streams. These include compliance and violation issues, total amounts of wastes generated, relative costs of waste disposal, waste toxicity, current or future availability of disposal technology, local community concerns, worker safety and exposure, anticipated future regulations, scheduled phase-out or restriction of chemicals (e.g., chlorofluorocarbons), regional environmental impacts, and energy and water consumption. A similar approach prioritizes pollution prevention projects for funding.

In practice, hazardous waste streams tend to be at the forefront of most efforts, with all other waste streams becoming secondary. This situation has evolved principally out of necessity due to the enormous expense of storing, transporting, handling, and disposing of hazardous waste. The short-lived Defense Environmental Restoration Account HAZMIN program serves as a good example of this focus. Under the program, projects related to hazardous waste reduction were funded at some 75 installations and activities to increase awareness of their potential long-term economic and environmental benefits. Another example is the current funding policy, which specifically targets hazardous waste disposal as a must-fund requirement but makes no particular reference to other waste streams.

Other Army initiatives include the Pollution Prevention Opportunity Assessment program mentioned earlier. This program will help identify and prioritize all processes and waste streams on an installation and help identify the most cost-effective approaches to reducing or eliminating them. Beyond this, the Army is also developing an integrated solid waste management program. The program will address the use of a combination of alternative solid waste reduction techniques that follow a hierarchy, similar to that established for general waste management. The solid waste hierarchy includes source reduction, reuse, recycling, composting, incineration, and landfilling.

Lastly, upcoming reporting requirements of the Emergency Planning and Community Right-to-Know Act and the Toxic Release Inventory will provide new ways to identify and prioritize waste streams.

Assessment and Recommendations

The Army program is well-founded in principle, but suffers somewhat in practice. While the continuing concern for the hazardous waste stream is genuine and well-founded, the Army must seek a more balanced approach. ***To accomplish this, the Army should move quickly to field the Pollution Abatement and Prevention Analysis model, and apply it rigorously to help prioritize projects at all levels.*** The model is designed to integrate data on pollution prevention technology, costs, benefits, and waste streams to produce alternative investment strategies. It is extremely flexible. By modifying variables and data inputs, one could use it to determine the relative priority of waste streams, based on a more holistic consideration of both hazardous and nonhazardous elements.

As recommended in an earlier section, ***the Army should also move to revise its must-fund policy to allow commanders more flexibility in deciding where and when limited resources should be applied.***

Element 8: Cross-Functional Teams

Cross-functional teams ensured that pollution prevention involved all operations and activities as much as possible. Two of the key areas for such use at the facility level were manufacturing and research and development. As with other essential elements, the degree of implementation varied among the benchmarked companies. At 3M, all employees were directly involved in the pollution prevention program to some degree (roughly 10 percent at any time). One permanent team focused on recycling efforts, while other teams were created as needed. Du Pont made the most extensive use of teams. These included a waste minimization team with five subteams — information and metrics, planning and implementation, outreach, facility opportunity, and training and recognition. The other companies used various types of permanent or long-term environmental teams, as well as shorter-lived teams tied to individual projects.

Army Program Element

The Army's use of cross-functional teams is limited primarily to the few installations and activities that are either implementing a hazardous material management system or considering doing so. These teams typically include environment, logistics, safety, and public works personnel. Additionally, the PPOA program involves both environmental and process personnel.

The process for developing pollution prevention plans similarly involves commanders, the environmental staff, and other key offices such as engineering and housing, logistics, contracting, safety, medical/preventive medicine, public affairs, as well as the activities primarily responsible for waste generation. All installations also must establish an Environmental Quality Control Committee comprising members representing the command, operations, engineering, planning, resource management, legal, safety, and medical interests. The Committee acts on a broad range of environmental issues, including pollution prevention initiatives and opportunities.

At HQDA, there is little or no cross-functional team activity, as the environmental media program area managers do most of the planning and program implementation.

Assessment and Recommendations

The Army has the necessary structure to use cross-functional teams, particularly at the installation level. As alluded to above, the PPOA and pollution prevention planning will ultimately involve the environmental community, process personnel, and representatives of other organizations and activities. To ensure that this happens, however, ***the commander and the installation pollution prevention champion must make a concerted effort to keep all of the key players actively involved.***

Another key area where the Army should increase its focus is the acquisition program. It is well known that the life-cycle costs of new systems increase dramatically when hazardous materials are used in system development or are required for system maintenance. In fact, the maintenance and disposal of some systems has been shown to cost more than the original development and procurement costs themselves. In consideration of this, ***program managers should consider establishing environmental policy councils or similar forums to ensure that pollution prevention programs receive strong, visible command support.***

Additionally, program managers should consider use of integrated (cross-functional) product teams, product development teams, environmental working groups, or similar functional teams. Their purpose would be to eliminate or substitute hazardous materials in design whenever possible, to ensure that design trade studies consider hazardous material impacts, and to evaluate life-cycle impacts of hazardous materials when determining system level impacts. An essential element of these teams would be the users (i.e., installation environmental managers and industrial maintenance and logistics staff) who must ultimately live with the fielded system. This promotes pollution prevention in all functional areas of the program and gets systems engineering, logistics, and other functional areas involved in pollution prevention and environmental management.

One related consideration would ultimately be to make the program manager responsible for cradle-to-grave system management. Under this approach, the program manager would control all funds for system-related issues, including operation, maintenance, and disposal. This would encourage more support for pollution prevention initiatives at all phases.

Element 9: Cost-Effective Investment

This element relates primarily to the funding of pollution prevention projects. Those facilities that were able to sustain their prevention programs did so by establishing their cost-effectiveness. While compliance was driven by regulatory requirements and did not have to compete for funding, prevention had to compete with other projects through the normal capital process. Overall, the companies surveyed used both financial (e.g., capital costs) and nonfinancial (e.g., public image) criteria to evaluate the cost-effectiveness of their prevention projects.

One common thread was that pollution prevention projects usually had to meet a specified rate of return on investment to win funding. Additionally, pollution prevention projects that were not cost-effective were specifically identified, and only a relatively small percentage of them were funded. While most companies competed prevention projects based on return on investment, there were exceptions. For example, Martin Marietta allocated 20 percent of facility capital to environmental programs, and subsequently required no financial justification for the individual environmental projects using that funding. Procter & Gamble allocated 20 percent of facility capital to environmental projects, but still required those projects to compete for funding through the capital budget process.

Army Program Element

The Army does not have a stand-alone investment strategy for pollution prevention projects. Attempts have been made to fence funding for prevention purposes, but success has been elusive. Unfortunately, legislative mandates such as eliminating ozone-depleting compounds and Clean Air Act requirements tend to force priorities, rather than rigorous analytical process. The Army provides general funding guidance through its environmental, pollution prevention, control and abatement report (RCS 1381) planning guide for identifying environmental program requirements. Project assessment codes (high, medium or low) are assigned to each project depending upon its priority. One of the key considerations in evaluating environmental projects is the payback from pollution prevention. Project submissions receive quality assurance reviews at the MACOM level, as well as at the Army Environmental Center.

Under the prioritization process, prevention projects are likely to receive a high assessment code only when they are specifically needed to meet the requirements of a statute or executive order, or if they have a projected payback period of two years or less. As detailed earlier, however, the current must-fund policy leaves installations with few resources for prevention projects, regardless of payback period or potential benefit.

Assessment and Recommendations

We have already addressed the deficiency in this area in previous discussions of the Army initiative to establish the Pollution Prevention Investment Fund. Under its proposed operating scheme, installations would submit prevention projects that would then compete for funding. Only non-must-fund projects would be eligible. Two primary considerations would establish priority for projects: economic factors (return on investment, manpower spaces saved, and internal rate of return), and categories of benefit. Benefit categories include reduced demand for the EPA's 17 targeted chemicals, reduced demand for other hazardous materials, and recycling of hazardous materials. The concept sets priorities using the Concepts Analysis Agency-developed Pollution Prevention and Abatement Analysis model.

Under this scheme, the Army would ensure that it funds the prevention program at effective levels, properly addresses all identified prevention requirements, applies limited funding wisely, and achieves the highest possible environmental benefit and return on investment. ***The Army must continue the effort to implement these initiatives by FY97 if it is to establish and maintain a viable investment program.***

ELEMENT 10: PROGRESS IS TRACKED AND COMMUNICATED

The presence of this element among the benchmarked companies indicates the importance of communicating the results of and the experiences with pollution prevention. Each facility could measure progress and publish results (usually against goals). A key finding of this study was that the best facilities generally were free to achieve established goals by whatever means worked best for them within their unique cultures. An important sideline to this was that while facilities looked toward corporate leadership for overall direction, goal-setting, and technology transfer, they did not want to be micromanaged or told how they should approach prevention. Perhaps more importantly, they did not want to receive unnecessary taskings for non-value-added data from above.

They all felt that pollution prevention achievements enhanced the company's public image. Typically, the company communicated results to key personnel at all levels. 3M published its results monthly at the plant level and quarterly at the corporate level. Du Pont and Martin Marietta reported annually to the corporate level. Intel used its quarterly newsletter to communicate progress. Monsanto took an extra step and provided annual reports to the public as well. (While all companies did not necessarily share specific progress with the public, each did establish an active general dialogue with the communities around their facilities.) Facilities indicated that it is not necessary or desirable to wait for either the perfect tracking system or perfect data before reporting results. Data quality can always be improved as the program matures. The key is to sustain awareness and encourage further improvement.

Army Program Element

The Army has established a foundation for tracking and communicating program results, but is not taking full advantage of the vehicles that are available. The Army used to have a quarterly outreach program for prevention in which major commands were brought together to discuss prevention program accomplishments. This has been discontinued, however, due to funding constraints. Video and teleconferences are now the primary communication vehicles. Other vehicles the Army uses to communicate results include such things as articles in professional journals and other publications, as well as a prevention section in the Army Environmental Center environmental newsletter. Electronic bulletin board systems and the Army Environmental Center alert program are also being used with success.

The Army published an overview of prevention initiatives in 1993 but it has produced no formal annual prevention report (as it has for compliance and restoration). However, prevention program accomplishments will be incorporated into a new annual environmental quality report beginning with the FY94 analysis. The only prevention data that has been tracked for this report, however, is limited to hazardous waste disposal, recycling, and general funding. Upcoming reporting requirements for the Toxic Release Inventory and Emergency Planning and Community Right to Know Act will help to expand available data.

Another promising initiative is the development of the Army strategic action plan for prevention. Within this plan, the Army has identified detailed program goals and objectives, along with associated performance measures (or indicators). Unfortunately, the strategic action plan exists primarily on paper, and the Army has made no real effort to acquire data or track performance against the established indicators. Installation prevention plans are also to include specific performance measurement criteria.

Assessment and Recommendations

The forthcoming annual environmental quality report will provide a major vehicle for communicating prevention program performance and achievements. More work needs to be done, however, to enable managers to track and assimilate prevention data. ***The Army should undertake a major effort to institutionalize the performance indicators identified in the strategic action plan and begin detailed tracking of performance against those indicators. To facilitate the collection and evaluation of this information, the Army must develop necessary data elements and add them to existing data bases, such as the Army Compliance Tracking System and the Environmental Compliance Assessment System. Annual reports and briefings to the senior leaders should then include results and trend analysis to assist them in making smart program management decisions.***

In addition, the Army should consider reinstituting some form of periodic pollution prevention conference to provide a forum for feedback and information exchange. One way to accomplish this would be to have major commands brief the results of their prevention programs at senior environmental leadership conferences.

Element 11: Quality Tools

It is generally recognized that private industry uses total quality management (TQM) and other quality improvement programs and tools extensively. Not surprisingly, quality improvement philosophies and tools were an integral part of all six companies' pollution prevention programs. For example, Du Pont included pollution prevention in its efforts to attain facility conformance with International Standardization Organization 9000 quality management and quality assurance standards. Martin Marietta used Pareto optimality analysis extensively for waste stream prioritization. Monsanto fostered a team-based quality culture to drive pollution prevention. Overall, use of quality tools was particularly evident in the area of process improvement.

A new buzzword in the private sector is TQEM, or total quality environmental management. The concept has been spearheaded by the Global Environmental Management Initiative, a group of 23 leading companies dedicated to promoting environmental excellence in business worldwide. Total quality environmental management follows a basic four-step process: identifying internal and external customers (and their needs); undertaking systematic, continuous business process improvement; focusing attention on the causes of problems rather than the symptoms; and adopting a systems approach to getting work accomplished. The approach's quality tools include cause-and-effect diagrams, Pareto charts, control charts, flow charts, and histograms. Benchmarking can be viewed as a component. TQEM modifies processes and products to improve environmental performance; benchmarking identifies how others have set up successful improvement programs.

Army Program Element

The Army has used basic total quality management tools and techniques for a long time. In 1988, the senior leadership voiced its support by stating that "TQM is a tool which must become an integral part of every functional activity at all levels, in every organization, government, and industry."[10] Army efforts are referred to as Total Army Quality, and this is now the basis for its management philosophy. The Army installation guide for pollution prevention planning stresses use of some of the TQM tools for identifying problem areas and establishing priorities.

The Pollution Prevention Opportunity Assessment program is a good example of ongoing total quality management efforts in that it focuses primarily on changing processes to prevent pollution. Perhaps an even better example, however, is the Army's ongoing participation in the Defense Environmental Security Corporate Information Management effort. In that venture, the Army is using total quality management techniques to integrate environmental strategies, business processes, data, information systems, technologies, and resources to meet all future functional and system requirements.

Although the effort is still in its early stages, substantial progress has already been made. For example, the DESCIM team recently announced its selection of a migration system that will ultimately result in fielding of the hazardous material management system. This change will eliminate multiple installation-level systems, improve control of hazardous materials, reduce hazardous material purchase and waste disposal costs, and improve both pollution prevention and compliance.

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[10] *Army Command, Leadership, and Management: Theory and Practice,* a reference text of the U.S. Army War College, 30 June 1994, pp. 2 – 12.

Assessment and Recommendations

The Army is making good progress in this area. However, ***it may be beneficial to investigate private industry's total quality environmental management more closely for potential application to the Army prevention program.*** This could be done initially at the Department of the Army level through attendance at or participation in future Global Environmental Management Initiative conferences.

ELEMENT 12: FACILITY AND INDIVIDUAL ACCOUNTABILITY FOR RESULTS

One means to ensure that individuals and facilities prevent pollution is to hold them accountable for their performance. The study revealed that responsibility (who has formal duty) and accountability (who actually answers for results) for prevention varied from the individual employee, to the environmental staff, to the plant manager. At 3M, the plant manager was responsible and accountable for pollution prevention results. Monsanto spread the responsibility to include not only the plant manager but the environmental staff as well, whereas Martin Marietta limited accountability to only the environmental staff. Procter & Gamble held all employees responsible, but also held waste generators accountable for the pollution prevention process. Intel had no specific assigned responsibility or accountability for the overall prevention program, but did have accountability at the project level.

Army Program Element

Army pollution prevention program responsibilities are clearly delineated in the 1994 policy memorandum, as well as in AR 200-1 and related regulations. Responsible agencies and activities include: the Assistant Secretaries of the Army for Installations, Logistics, and Environment, Research, Development, and Acquisition (ASA[RDA]), and Financial Management; Army Acquisition Executive; Deputy Under Secretary of the Army for Operations Research; Assistant Chief of Staff for Installations Management; Director of Environmental Programs; Deputy Chiefs of Staff for Logistics and Operations and Plans; Inspector General; Judge Advocate General; Surgeon General; Director of Army Safety; Chief of Engineers; Commanders of all major commands, installations, Reserve Components and tenant activities; and the Director of the Army Environmental Policy Institute. In each case, responsibilities are assigned on the basis of general functional area association. In effect, virtually every agency and activity within the Army has some degree of responsibility for program implementation and success. This is exactly how it should be.

Unfortunately, while assigning responsibility is one thing, establishing accountability is quite another. In the final analysis, it is usually the environmental program staff (at all levels) who carry the ultimate burden of program success.

Assessment and Recommendations

The Army has done a fairly good job of assigning responsibility (on paper), but needs to do more to ensure that appropriate parties are held accountable for program successes and failures. This should specifically include those who are directly responsible for waste generation (e.g., process managers). To help achieve this, ***the Army should investigate whether to include pollution prevention responsibilities in individual job/duty descriptions for both civilians and military personnel. This could be carried one step further by including prevention in the performance review, efficiency report, and compensation processes as well.***

Element 13: Program Patterned to Corporate Culture

Understanding the corporate culture and patterning pollution prevention to it is a key consideration, because oftentimes corporate cultures are not amenable to change. As a result, many barriers will surface when major programs such as pollution prevention are introduced. Corporate cultures vary (e.g., quality-driven, management-driven, team-driven). The better the understanding of that culture, the easier it is to surmount those barriers.

As indicated earlier, each benchmarked company allowed flexibility to implement pollution prevention based on what would work best within their individual cultures. This was contrary to the top-down, management-driven approach too commonly utilized. By developing their own solutions, employees and program managers gained a sense of ownership in the program, which in turn led to greater motivation and a higher likelihood of success. All six companies studied used the facility-based approach to managing pollution prevention.

Army Program Element

Army culture has evolved over the last two centuries — a very long and historically significant period. For the most part, that culture has focused on transforming available resources into combat-ready forces that are organized, trained, and equipped to carry out the national defense mission. Any program or activity thought to degrade that focus will experience considerable difficulty in implementation, growth, and ultimately in survival.

Generally speaking, the Army environmental program has infused its ethic within that culture, by obtaining the senior leadership's firm commitment. This commitment is embodied in its overarching environmental strategy, which provides a framework to ensure that environmental considerations will be an integral part of the Army mission, and that an environmental stewardship ethic will govern all Army activities. As a key pillar of that strategy, prevention will ultimately move up to assume its rightful place at the forefront of the effort. (But even this represents a major cultural change from the traditional approach, which emphasized end-of-pipe control of waste.) The real challenge will be to ensure that everyone, from the Army staff down to each individual, is truly on board and supports the program.

As in the private sector, the Army philosophy has been to push prevention to the lowest possible level — the installations and activities. All installations are to establish multimedia pollution prevention plans. Commanders are to ensure that these plans identify an approach to reducing all environmental damage, not just waste generation. The commanders are specifically to include resource requirements, implementation schedules, milestones, performance measurement criteria, cost-benefit analysis, as well as implementation barriers. They must also address emergency operations, safety, and health requirements.

Beyond this planning mandate, commanders are free to implement programs as they see fit within available resources. This provides the essential sense of ownership in the program that will ultimately ensure its success.

Assessment and Recommendations

While the environmental (and pollution prevention) ethic has been firmly introduced into the Army's corporate culture, it has met and will likely continue to meet some resistance at all levels. Historically, commanders have viewed environmental programs as something of a thorn in their side, serving only to divert attention and scarce resources that could otherwise be applied to improving combat readiness. This mindset is slowly beginning to change; encouragingly, many commanders now realize that being able to maintain that readiness capability is precisely the reason why they *should* embrace prevention.

In other areas progress is coming more slowly. Many of the Army's ways of doing business are long established, and there is often great reluctance to accept change. For example, the Navy and Air Force have found the pharmacy concept for hazardous materials management to be extremely successful for preventing pollution. They are moving quickly to implement the practice at all of their installations. In conjunction with the DESCIM effort, DoD corporate philosophy is moving toward the concept as its preferred business practice.

In spite of this demonstrated success and high-level endorsement, the Army's logistics community has been overcautious in recognizing its potential and applicability to Army activities. Reasons cited for this include the notion that the pharmacy concept is costly and labor-intensive, and duplicates portions of the existing supply system. Upon closer examination, however, these arguments appear to be unfounded, and may result from the inertia that can sometimes set in when organizations get too accustomed to existing ways of doing business.

If the Army is to overcome this type of resistance, it must relentlessly drive home the idea that indifference to pollution prevention can place combat readiness at significant risk — and that its proper application in all operations and activities represents a significant force multiplier.

Element 14: Appropriate Recognition to Motivate Employees

Each of the companies recognized that sustaining employee motivation was critical to ensuring program success, and established some type of reward or recognition program to do so. In particular, immediate recognition of early accomplishments often induced employees to strive for better performance. In many instances, it also served to bolster the initial impetus for establishing the program.

The types of awards presented and the presentation level varied. At Du Pont, recognition came from both peers and management. Intel recognized major achievements through a formal division-level award, while encouraging peer recognition for other achievements. Procter & Gamble allowed its employees to initiate virtually any reasonable pollution prevention project. Both Procter & Gamble and Du Pont strive to make pollution prevention personal and "fun" for employees. Monsanto did not recognize the achievement of specific goals because it wanted to promote *continuous* improvement; instead, its motivational efforts focused on making the pollution prevention "journey" through continuous improvement fun.

Army Program Element

Pollution prevention awards are addressed through the Army environmental quality awards program. These awards recognize individuals, units, activities, and installations for outstanding accomplishments in prevention. Recognition is given for outstanding leadership in prevention program management, process improvements resulting in waste reduction, and other innovative approaches. The awards are designed to motivate individuals and commanders at all levels to achieve higher standards of excellence, and to create healthy competition to improve the Army's overall pollution prevention.

The Secretary of the Army presents an environmental quality award to the individual and installation that have made the most noteworthy contributions toward preserving and protecting the environment through pollution prevention. Installation awards fall into two categories: industrial and nonindustrial. There is also a team acquisition award. One winner is selected from each category. Installation awards include cash payments that may be used for any bonafide welfare, recreation, or morale purpose. The program is funded at $600,000 for FY95.

Assessment and Recommendations

The Army awards program is firmly established and is meeting its overall objective. One key area of opportunity that should be expanded, however, is the acquisition program. Given the tremendous payback potential in this arena, ***the Army may wish to consider establishing a separate individual award category to recognize excellence in pollution prevention in acquisition.***

Element 15: Corporate Resources

The interdisciplinary nature of pollution prevention provides ample opportunity to utilize resources from throughout the organization. All companies ensured that pollution prevention managers had access to all available corporate resources for program implementation. This specifically included resources outside the pollution prevention area, such as general engineering, material services, maintenance and industrial hygiene staff, marketing, and research and development.

Each facility utilized corporate engineering divisions as a resource for technology transfer and research. Intel and Martin Marietta also worked with outside suppliers. Additionally, Intel provided cross-facility environmental engineering workshops that were held for three days every six months. Corporate environmental offices provided the bulk of necessary resources for the 3M and Du Pont facilities.

Army Program Element

Organizationally, Army environmental program management offices are generally located within the Directorate of Public Works. This affords the environmental staff easy access to outside resources, such as public works technical expertise, vehicles, equipment, and to a lesser degree, even funding. Some offices are elevated to higher command levels for added visibility and emphasis (e.g., Directorate of Safety, Health, and Environment). In these instances, they may have additional access to or influence with available resources across the entire installation.

At higher echelons, outside access is difficult to achieve at best. When specific pollution prevention responsibilities are assigned to external agencies (e.g., ASA[RDA]), a portion of their resources is applied to support the prevention effort. But all activities are experiencing the same resource shortfalls. For example, the R&D community is charged with developing technology that eliminates or reduces sources of pollution and minimizes the generation of hazardous wastes and harmful emissions from certain industrial and base support operations.

The reality, however, is that limited resources and competing priorities leave no exploratory/advanced development funding available for prevention. Defense Environmental Restoration Account funding was once reserved for hazardous waste minimization, but that program has since been eliminated. The only significant advancement in this area has been that the field now has some input for prioritizing R&D projects.

Efforts that may help improve this situation include such things as the National Defense Center for Environmental Excellence, for which the Army serves as DoD Executive Agent. The Center's research leverages the capabilities of

DoD, other government agencies, and private industry to solve users' identified technology requirements.

Assessment and Recommendations

This is clearly an area where the Army must improve, but there is no simple solution. The continuing Army drawdown will only increase demand for dwindling resources, and agencies will be even more reluctant to share what little they have. One possible solution has already been addressed in previous discussions regarding the Pollution Prevention Investment Fund. ***The Army should move to establish a fenced source of funds for pollution prevention investment that is separate from the Environmental Compliance Achievement Program (and the Defense Environmental Restoration Program, ideally to be run under the recently established management decision package VEPP (pollution prevention). Another alternative would entail bringing back the Productivity Enhancing Capital Investment Program, which provided funding for capital projects with high potential return on investment.***

In addition, the Army should seek out and effectively utilize outside resources. These would include such things as free services provided by the EPA and similar agencies, joint Service and/or private industry partnerships, and other approaches that pool resources to achieve common goals and objectives.

ELEMENT 16: POLLUTION PREVENTION INTEGRATED INTO PREMANUFACTURING DECISIONS

All six companies' pollution prevention programs incorporated the concepts of life-cycle design and life-cycle assessment.[11] They also worked extensively with raw material suppliers, equipment suppliers, and customers to involve them in prevention within facility processes and products. Monsanto, 3M, and Du Pont each fully integrated pollution prevention throughout the product life cycle, from research and development to customer delivery. Monsanto went even further by working to imbed pollution prevention concepts into the product's ultimate disposal.

Army Program Element

The Army acquisition community is aggressively pursuing this issue. The Army Acquisition Pollution Prevention Support Office, located within the Army Materiel Command, is supporting the Army Acquisition Executive, procurement executive officers, and acquisition program managers to ensure that pollution prevention concerns are considered throughout the acquisition program.

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[11] Life-cycle assessment evaluates the environmental effects of any given activity from the initial gathering of raw material from the earth until the point at which all residuals are returned to the earth. Life-cycle design considers the environmental impacts of a proposed product throughout its life cycle.

This includes employing pollution prevention contracting practices, conducting programmatic environmental assessments over the life cycle of weapons systems, integrating prevention policies into program master planning documents, and instituting life-cycle pollution prevention cost accounting procedures to facilitate business decisions. The support office has played a key role in identifying and, where possible, eliminating the use of hazardous substances in Army standards and specifications. It has also been instrumental in developing a comprehensive program to replace ozone-depleting compounds in Army weapons systems.

Assessment and Recommendations

The Army's overall performance in this area has been exemplary. ***Scheduled changes in acquisition regulations, modifications of the Federal Acquisition Regulation (FAR)/Defense FAR Supplement, and implementation of National Aerospace Standard 411 should proceed without delay.***

ELEMENT 17: NEW TECHNOLOGY

Tracking and utilizing new technology has increased the success of each company's pollution prevention program. Each tapped into a variety of sources for information on new and emerging technology. These included corporate research groups, in-house developments R&D, outside vendors and consultants, directed university research, trade journals, professional associations, partnerships with other companies, internal technology transfer meetings, and trade associations. Procter & Gamble was unique in that its primary source of information on new technology was its own employees. It did, however, also gain information from suppliers and waste brokers.

Army Program Element

The Army is pursuing similar avenues. The Armament, Research, Development, and Engineering Center has been spearheading the technology development effort in coordination with AMC's research and development centers, the Army Research Office, Army Environmental Center, and other key environmental and manufacturing technology resources.

Army techbase R&D programs stress two general priorities for new technologies: supporting future weapons systems and resolving Army-unique pollution prevention problems. In this latter regard, priorities are eliminating ozone-depleting compounds, metals surface finishing and cleaning, ordnance manufacturing and development, coatings application and removal, advanced materials, energy considerations and greenhouse gas emissions, general base support, and nonhazardous solid wastes and packaging. User requirements have been identified and are integrated into the Tri-Service Environmental Quality R&D Strategic Plan.

The Army also serves as DoD's Executive Agent for the National Defense Center for Environmental Excellence, a vital source of expert scientific, engineering, laboratory, and demonstration factory support services for the technology development effort. Through the Center, the Army has been able to interface with trade groups and manufacturers to enhance communication and information transfer.

The Army participates in a number of partnerships as well. For example, in 1991 the Army signed a Tidewater Interagency Pollution Prevention Program (TIPPP) memorandum of understanding with the Navy, Air Force, NASA, and EPA to cooperate in the Chesapeake Bay region. The agreement established a framework for implementing pollution prevention projects and initiatives at all TIPPP facilities. The program is designed to develop innovative prevention technologies and facilitate their transfer among the participating Services and agencies.

Assessment and Recommendations

The Army is making progress in this area. However, its strategic action plan for pollution prevention recognizes that research and development is fragmented, with no single organization managing or tracking the entire effort. ***There is an identified need to capture into one Army plan all environmental R&D that is not system-specific.*** The strategic action plan offers the Army's *Environmental Quality Long-Range Science and Technology Plan,* published by the Corps of Engineers, as the best document for this purpose. In addition to this issue, we have already stressed the lack of 6.2/6.3 funding for pollution prevention R&D.

ELEMENT 18: EFFECTIVE COMMUNICATION TO INCREASE AWARENESS

Adequate awareness of a company's pollution prevention program by its employees often translates into more active participation and thus greater success. Each facility studied had an established communication process within the facility as well as between facilities. Du Pont and 3M both published success stories. The others published articles in facility newspapers or magazines. Martin Marietta's environmental group employed a manager of environmental communications who regularly published pollution prevention success stories. Procter & Gamble and 3M also published information through corporate level media, including annual environmental reports and corporate newsletters. Procter & Gamble also published a monthly recycling report and goals update. Monsanto and Du Pont both made use of electronic mail to communicate with facility employees. To foster interfacility communication, 3M set up best practices meetings in which facilities had the opportunity to present and discuss their experiences.

Army Program Element

The Army's efforts to increase pollution prevention awareness are beginning to gain momentum. In addition to conferences, awards, articles, news alerts, posters, and videotapes, the Army has produced and distributed several informative pollution prevention publications. These include an overview of pollution prevention trends, forecasts, and options for the Army; Army pollution prevention success stories; a mission-area pollution prevention guide; a pollution prevention planning manual; a unit-level handbook on hazardous material and hazardous waste; a materiel developer's guide for pollution prevention; a technical guide for developing integrated solid waste management programs; a guide outlining ways to reduce office waste; and a guide for reducing waste in the food service program.

Assessment and Recommendations

The Army is generally doing a good job of communication internally. ***It may be beneficial to increase its external focus — informing local communities, private interest groups, regulators, and Congress of program activities and success — in order to build long-term support for the prevention effort.***

Army Prevention Program Assessment Summary

As reflected in Figure 2-1, the Army has substantial work to do to achieve best-in-class performance levels. It should emphasize primarily the six elements that are unsatisfactory overall (have minimal or no implementation). The remaining 12 elements rated as having moderate or higher implementation (satisfactory overall) are of lesser concern, although the Army should make every effort to implement all elements completely as quickly as possible.

While this exercise involved considerable subjective analysis, it shows that even minimal information about best-in-class performance can enable an organization to critique its own operations and identify areas for improvement.

Time and Cost Considerations

A major issue facing the Army as it evaluates benchmarking is funding: the current fiscal climate does not allow for spending largess. Also, little spare time is available to the Army Staff. The American Productivity and Quality Center/International Benchmarking Clearinghouse find that a typical benchmarking study involves the following resources:

- It requires a team of five to seven people working one day per week on benchmarking.

- The study may last 6 months or more; the average ranges from 3 to 12 months.

- The expected costs (excluding implementation of any recommendations) range from $35,000 to $70,000.

These data are based on studies conducted primarily by corporations, many of which have had some experience with benchmarking or other total quality management concepts and processes. Nevertheless, these figures do not seem to represent an insurmountable barrier to the proposed Army effort. Also, if the use of third-party assistance is assumed, time constraints may be greatly relaxed.

The next and final chapter draws conclusions on the utility of benchmarking, and outlines a strategy to determine the best approach for integrating formal benchmarking into the Army's pollution prevention program.

CHAPTER 3

Summary and Proposed Strategy for Applying Benchmarking to the Army Pollution Prevention Program

Based on a general review of benchmarking and specific case studies in the public and private sector, we conclude the following:

- Benchmarking is a widely utilized quality management tool that can be valuable for improving performance. More particularly, some organizations have used benchmarking to study exemplary pollution prevention programs and improve their own.

- While the Army has not undertaken any formal benchmarking studies, it regularly employs many of the technique's underlying principles.

- The Business Roundtable benchmarking study, which identified 18 critical and essential elements of the best pollution prevention programs, has direct and immediate relevance for the Army's program.

- The time and resources required by the benchmarking process do not seem like an insurmountable barrier to the proposed Army effort, particularly if the use of third-party assistance is assumed.

Clearly, benchmarking is a tool that can be of value in developing a state-of-the-art pollution prevention program. However, as with any new undertaking, it is not something that should be blindly pursued as a sole solution or cure-all for every problem that arises, and we note the following cautions:

- The success experienced by benchmarking practitioners largely has been due to their willingness to commit the necessary time and resources to conduct high-quality studies and implement required changes.

- None of these companies started with elaborate benchmarking projects; rather, they began with small yet meaningful studies that gradually allowed them to gain experience with the process. Generally, it is recommended that organizations new to benchmarking start with smaller projects which are deemed to have a high likelihood of success. An early success motivates organizations to continue such efforts and enhances their willingness to take on more complicated projects.

- The Army cannot benchmark the entire pollution prevention program. Instead, only those components most amenable to benchmarking should be selected for study.

- Effective use of formal benchmarking ultimately requires complete understanding of the processes involved and strong management commitment to effect requisite change. As the example of the Department of Energy illustrated, undertaking formal benchmarking studies before an organization is totally ready can lead to disappointing results and a loss of focus.

RECOMMENDATIONS

In view of benchmarking's potential benefits as well as its limits, we recommend the following courses of action.

Evaluate Benchmarking in Phases

The Army should pursue a deliberate, measured, and rational approach to determine to what degree benchmarking can or should be integrated with other quality management tools to support the pollution prevention program. A logical strategy would be to work in phases, initially to increase general awareness of the benchmarking process and its potential, and to possibly begin some small-scale benchmarking activities. Depending on the degree of success, the Army could then move forward with more ambitious projects, and ultimately, establish a formal benchmarking program if desired.

We recommend the following phases and actions to execute such an approach.

PHASE I — ESTABLISH FOUNDATION

- Distribute this report at least to the major command level. The major commands could initially review and evaluate it for themselves, and disseminate information and guidance to installations as they deem appropriate.

- Ensure that the existing prevention program is operating on the soundest possible footing or baseline. To accomplish this, the Army should establish realistic timelines and track progress at all levels (installations through the HQDA) in complying with program requirements (i.e., those specified in applicable regulations, policy letters, etc.), as well as fully implementing the 18 essential program elements discussed in Chapter 2. We have already provided recommendations in that chapter that should help implement those elements.

- Encourage major commands and installations to apply basic benchmarking principles in day-to-day pollution prevention program operations and activities, and, where appropriate, consider training selected personnel in the benchmarking process.

- The Office of the Director of Environmental Programs (ODEP) should pursue active membership in the International Benchmarking Clearinghouse[1] and the Global Environmental Management Initiative. This would afford the opportunity to keep abreast of ongoing pollution prevention benchmarking and initiatives in total quality environmental management, benefit from their results, and possibly even participate to a limited degree in selected studies and conferences. This in turn would enable senior Army program managers to better evaluate benchmarking's overall potential, while minimizing up-front resource requirements.

- Identify existing processes that constitute the pollution prevention program. Determine which are most suitable for benchmarking, and which specifically are not. Prioritize them for possible improvement, based on actual or perceived efficiency of operations.

Phase II — Explore Process at Installation Level

Depending on the outcome of Phase I,

- have selected HQDA (ODEP)[2] pollution prevention staff undergo formal benchmarking training,

- have ODEP fund, plan, organize, and conduct an internal installation-level benchmarking demonstration study[3] that targets a specific process (e.g., hazardous waste disposal),

- announce the findings of the demonstration study and begin implementing its recommendations as appropriate, and

- brief Army senior leadership on the results and implications of the demonstration study.

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[1] Blanket membership in the IBC has already been established for the Federal government. Individual agencies need only activate their membership (which is at a much lower rate than for private organizations). If desired, membership can be restricted to only the AP&QC library, which permits accessing all resources, to include benchmarking references, case studies, etc.

[2] If Army staff workload does not permit this, the Army might alternatively consider training Army Environmental Center and/or the National Defense Center for Environmental Excellence staff to undertake subsequent activities.

[3] While it is recommended that this study be conducted by Army personnel, time and resource constraints may make this impossible. In this case, the Army could make use of a third party for support, or to even conduct the entire study independently.

PHASE III — EXPLORE PROCESS AT MAJOR COMMAND LEVEL AND ABOVE

Depending on the outcome of Phase II,

- encourage and support similar benchmarking initiatives among all installations;
- organize and conduct a similar demonstration study between MACOMs. Focus on a specific process improvement or more general pollution prevention program elements;
- team with other DoD Component prevention program offices to conduct a study (internal or external) targeting an area of mutual interest;
- formally participate (ODEP) in a pollution prevention benchmarking study sponsored by the International Benchmarking Clearinghouse and involving private industry and/or other Federal agencies; and
- publicize the results across the Army, and brief senior leadership on the outcome and implications.

PHASE IV — IMPLEMENT FORMAL BENCHMARKING PROGRAM

Depending on the outcome of Phase III,

- provide resources for and establish a formal benchmarking program with the ODEP pollution prevention division (or possibly the NDCEE) as the lead action office,
- publish detailed HQDA guidance on program policies, procedures, goals, and objectives,
- closely monitor the benchmarking program and its overall results, and
- periodically review and assess the program in order to validate a continuing need for HQDA-level oversight. If appropriate, delegate authority for continued execution of the program to major commands.

Screen Benchmarking Topics Carefully

To make more efficient use of time and monetary resources, it is critical that the Army understand which portions of its pollution prevention program are best suited for benchmarking. Below is a preliminary list of suggested benchmarking topics by mission area. We developed this list from an analysis of the program areas delineated in the current Army strategic action plan for pollution prevention, and process information identified by the *Army Mission Area Pollution Prevention Guide.*

As indicated under Phase I activities, this listing should be carefully revised, developed, and prioritized before undertaking any formal studies. Many of these topics are unique to the military; hence the only potential benchmarking partners would likely be comparable organizations within the other DoD Components.

Systems Acquisition

a. Integrating pollution prevention into the systems acquisition life cycle

b. Assessing life-cycle environmental impacts

c. Integrating pollution prevention into the development of specifications and standards

Logistics Support

a. Improving general hazardous material management

b. Reducing hazardous material use and purchases; increasing use of non-hazardous substitutes

c. Identifying alternative uses for recycled maintenance-related hazardous materials

d. Implementing environmentally friendly packaging programs

e. Reducing energy consumption; identifying alternative fuels and more energy-efficient equipment

f. Minimizing hazardous waste generation and disposal

g. Establishing more effective recycling/reuse programs

Doctrine and Plan Development

a. Establishing procedures to minimize environmental effects of warfighting and training activities

b. More effectively integrating requirements of the National Environmental Policy Act into Army doctrine and planning

Force Structure and Readiness

a. Integrating pollution prevention considerations into the force development process

Training

a. Developing and implementing effective pollution prevention training (military and civilian) at all organizational levels

b. Integrating pollution prevention into all training activities that generate waste or affect the environment

c. Integrating pollution prevention considerations into the training development process

Infrastructure

a. Integrating pollution prevention considerations into the infrastructure development process

b. Investing in environmentally protective designs, facilities, and technologies ("green" facilities/design for the environment)

c. Improving energy and water conservation practices

d. Identifying and investing in equipment that prevents pollution

e. Integrating pollution prevention into land management practices

Industrial Operations

a. Improving hazardous waste minimization programs

b. Identifying general pollution prevention opportunities at industrial facilities

c. Reducing the acquisition of products that contain hazardous or toxic chemicals

d. Identifying environmentally conscious contractors

e. Improving facility management practices for storing hazardous materials

f. Eliminating or reducing the storage and disposal of off-specification products through recycling, material exchange, or resale

g. Reducing water consumption during industrial operations and activities

h. Improving waste stream analysis and segregation procedures

i. Identifying and employing state-of-the-art pollution abatement technology

j. Modifying processes to reduce effluents and emissions

k. Integrating pollution prevention considerations into the design of new industrial facilities

Base Operations

a. Improving pollution prevention planning and management structures

b. Improving cultural and natural resource management plans and techniques

c. Establishing integrated waste management programs

d. Integrating pollution prevention considerations into installation standard operating procedures, policies, and directives

e. Establishing more effective recycling programs

Health and Medical

a. Improving general management of infectious medical wastes

b. Identifying less hazardous alternative materials for use in medical and research laboratory facilities

c. Reducing employee exposure to medical wastes

d. Minimizing generation of medical wastes

e. Identifying new treatment technologies for medical waste streams

Transportation

a. Implementing more effective pollution prevention technologies and procedures in vehicle maintenance operations

b. Improving vehicle fuel efficiency

c. Minimizing leaks and spills from transportation equipment

d. Improving hazardous material recycling and reuse activities

e. Reducing energy consumption through improved transportation management practices

Mobilization and Deployment

a. Integrating pollution prevention considerations into mobilization and deployment planning

b. Improving storage and handling procedures for hazardous material contingency stockpiles

c. Improving packaging of deployable supplies to minimize weight and volume

d. Reducing solid waste generation during mobilization and deployment

e. Minimizing emissions from industrial facilities when mobilization requirements force expanded production

f. Conserving energy during troop augmentation

g. Minimizing mobilization and deployment impacts on wastewater treatment and other environmental support facilities at installations

Research, Development, Testing, and Evaluation

a. Identifying pollution prevention technology requirements

b. Identifying viable pollution prevention technologies

c. Minimizing wastes generated during RDT&E activities

d. Using RDT&E to address existing and future environmental challenges proactively

a. Establishing and monitoring pollution prevention program performance indicators/measurements

b. Developing comprehensive pollution prevention program alternative investment strategies

c. Developing alternative pollution prevention program funding strategies

Rule Out Benchmarking if Solutions Are Known But Funding Is Absent

A review of the strategic action plan for the Army pollution prevention program reveals that many of the key program elements suffer from a general lack of funding. This lack of funding may be the principal, underlying cause of gaps between the Army and best-in-class pollution prevention programs. If this is in fact the case, then benchmarking is not the solution.

It is possible, of course, for one organization to compare its operating costs against those of another in order to identify potential savings. In general though, organizations must first determine whether there are problems for which the solutions are known, but not implemented due to some internal political or budgetary reasons. In the final analysis, such things do not need to be benchmarked.

APPENDIX A

Benchmarking Basics — Details of the Formal Benchmarking Process

Benchmarking Basics — Details of the Formal Benchmarking Process

There is often misunderstanding over exactly what the benchmarking process entails. For example, benchmarking is commonly confused with industrial tourism — simply visiting a partner's site and observing their processes and operations. As illustrated below, the benchmarking process begins before one visits or even contacts a partner.

Practitioners and promoters of benchmarking have identified various steps and procedures which make up the benchmarking process. One of the most widely used systems is that developed by AT&T and the Wharton School of Business. It outlines nine basic steps for a benchmarking study, which include project conception, planning, initial data collection, best-in-class selection, best-in-class data collection, assessment, implementation planning, implementation, and recalibration.

Regardless of the specific steps developed for any individual study, its elements will fit into the four core phases that the American Productivity and Quality Center has identified:

- Plan
- Collect
- Analyze
- Adapt

The sections that follow explain in more detail each of the phases in this strategy, sometimes known as the PCAA model.

Phase 1: Plan

Planning is the most time-consuming and critical stage of any benchmarking study, and can be expected to make up roughly 50 percent of the overall project. At this stage, an organization determines what it wants to benchmark by asking and answering questions such as:

- What is our organizational strategy?
- Who are our customers? What do they want?

Once a process has been selected for benchmarking, additional questions must be answered:

- What is the scope of the process we are going to benchmark?
- How does that process work and how do we measure it?
- What types of measurement data are required?
- What do we want to learn about the process from our benchmarking partners?

With these questions answered, the organization moves on to collect internal and external data.

PHASE 2: COLLECT

> Collecting data is much like collecting garbage . . . you must know in advance what you're going to do with the stuff.
>
> — Mark Twain

Collection of accurate internal data drives the overall success of a benchmarking study. Adhering to the adage "know thyself" will enable an organization to design a well-focused study and develop stronger relationships with partners. By first looking at internal operations and processes, one can identify performance variables and metrics for establishing a baseline, catalog areas that are problematic, and develop a preliminary set of questions that the benchmarking effort needs to answer.

In many cases, "entitlements" are identified during this introspective phase. Entitlements are improvements that can be made without a major change or a significant investment (e.g., a process modification having no capital cost outlays). By identifying entitlements, an organization can ensure that its benchmarking study will focus on those truly complex issues that are not so easily managed.

After this internal assessment, organizations considered to be the best in their class for the process under study must be identified. As might be expected, best-in-class companies receive many requests to participate in benchmarking studies. Due to the plethora of such requests, however, these companies simply will not benchmark with those who are ill-prepared or have not done their homework. Thus it is imperative that project planning and internal data collection be effective and timely.

Secondary research and the utilization of publicly available information are useful tools for collecting data on potential benchmarking partners. They can help to narrow the list of potential partners without excessively taxing available resources. Additionally, it is often helpful to ask organizations such as established societies, private interest groups, and regulatory agencies to assist in the partnering search. For example, if there is an interest in finding partners known for their expertise in application of the National Environmental Policy Act, the Environmental Protection Agency, Council on Environmental Quality, and Sierra Club might be asked to assemble a list of the organizations they consider to be best-in-class. A subsequent cross-check to identify those organizations appearing on all three lists would likely produce a good set of potential candidates.

After a subset of potential partners is identified, it is common to send out a screening survey which asks for more detailed information. This information would then be used to make the final best-in-class determination.

Once partners are selected, the external data collection phase begins. Site visits, conference calls, in-depth surveys, and questionnaires are the most common methods.

Phase 3: Analyze

Data analysis is used to identify performance gaps, those differences between one organization's performance (based on the aforementioned performance variables and metrics) and that of the "best-in-class" performers. The challenge is to ultimately identify the root causes of these gaps as well as the "enablers" that allow the best-in-class organization to excel. Enablers are practices, methods, or processes that enable the best-in-class organization to develop and maintain the best practices. Identifying enablers is probably the single most important component of benchmarking; the goal is not to merely discover what the best do but how they do it.

Phase 4: Adapt

It is essential to distinguish between "adopting" and "adapting" when benchmarking. Benchmarking is not a process of mere copying; rather it is an opportunity to adapt enablers to one's own environment. Benchmarking encourages managed change. The gap between internal and external practices creates the need for change. Highlighted best practices indicate what must be changed, and benchmarking provides a picture of the potential results from that change.

This adaptation will involve several activities. For example, an operational plan and an overall implementation strategy must be developed. Ideally, an implementation team or teams will be formed to draw up detailed plans and secure the involvement of all key stakeholders (management and employees). Management then approves the plan and communicates its vision for the future.

At this point, management must provide strong support for the benchmarking effort to help overcome any resistance and obstacles. Progress and performance should be monitored against milestones and interim objectives. Periodic progress reports should be furnished to the specific managers who are sponsoring the benchmarking effort. Lastly, the changes that have been initiated should be formalized (institutionalized) and fine-tuned as needed.

Following implementation, it is important to plan for continuing reassessment of the process or product that has been improved. This will include periodically monitoring industry trends, identifying environmental and organizational situations that could trigger future benchmarking studies, and possibly integrating benchmarking into the organization's overall strategic planning process.

Note that sometimes a benchmarking study will identify practices and enablers within another organization that simply cannot be adapted. Knowing what cannot be changed is just as important as knowing what can. If adaptable practices are identified, it is critical to completely understand the enablers that support the practices.

The questions are often asked, "What do I do after I benchmark?" and "What if I am already the best?" These two questions reveal a common misunderstanding of what benchmarking really is. As already stated, benchmarking is a continuous learning process for an organization. After one benchmarking study is conducted, it may be prudent to complete another one on a different process or, at the very least, continue to check regularly for new best practices for the same process.

An important point to remember is that *benchmarking is not a solution for every problem or issue that arises,* nor is it meant to be. Benchmarking is a tool that enables an organization to identify potential solutions and learn more about itself in the process. Following the above steps greatly increases the chances for success, namely, identifying meaningful enablers; failing to follow them may lessen the chances. With this in mind, one should note nine common benchmarking mistakes to avoid:

- Leaving internal processes unexamined
- Improperly establishing scope — setting parameters too broadly
- Focusing too much on metrics instead of processes
- Proceeding without team commitment
- Not doing enough homework before collecting data
- Selecting the wrong benchmarking partners

- Ignoring comparisons outside the benchmarked industry
- Failing to follow up and implement findings
- Proceeding without management commitment.

APPENDIX B

Case Study No. 1: Focused Benchmarking — "Kodak Class" Maintenance

Case Study No. 1: Focused Benchmarking — "Kodak Class" Maintenance

This case serves as an example of a focused study; in addition, it simultaneously illustrates both internal and external benchmarking. Furthermore, it shows how benchmarking can be conducted within a multinational organizational environment. For conformity, we present the case in a format that parallels the four core phases of the plan, collect, analyze, and adapt (PCAA) model.[1]

Background

As with many other large corporations, benchmarking is a widely used tool within Eastman Kodak. It has proven successful because it empowers employees by providing them with a tool to measure their performance, and the requisite knowledge to make needed improvements. For example, maintenance departments at different Kodak facilities measure their own efficiency and compare the results with other departments. Because they are evaluating themselves, workers feel that they are accountable for their performance. Additionally, less efficient departments are able to adapt desirable practices from the more efficient ones.

Eastman Kodak's maintenance program (managed through Kodak Maintenance) is based upon a strategic framework that translates customer needs into specific improvement projects. In essence, it details the key strategic thrusts of the maintenance business and how they are to be achieved. The framework includes the mission and vision of the business, the key result areas for success, and the major improvement opportunities that will drive improvement in performance. In all, there are four key result areas: maintenance excellence, personnel development, technology networking, and personnel deployment. Benchmarking is linked to maintenance excellence in the strategic framework.

Kodak Maintenance provides general engineering and maintenance support services to all Kodak facilities worldwide. Kodak Park Maintenance, one of its subordinate facilities, provides services in the areas of reactive (emergency) maintenance, preventive/predictive maintenance, equipment troubleshooting, workload planning and scheduling, new equipment design and installation, maintenance program management, and spare parts management.

[1] Information detailed here extracted from *Kodak Class Maintenance: Benchmarking, Our Measure to the Future*, by Berson, Harvey; Geisler, Nancy; Lindenmuth, Todd; Madigan, James; Weber, Allen, Eastman Kodak Company, Rochester, New York. This benchmarking study received the 1994 Gold International Benchmarking Award issued by the International Benchmarking Clearinghouse.

Planning

In January 1992, Kodak Park initiated a benchmarking program involving both internal and external partners in an effort to reduce the amount of reactive maintenance work, and to lower maintenance costs as a percent of overall manufacturing costs. The program focused on reactive maintenance, preventive/ predictive maintenance, and spare parts management. Corporate managers felt that internal benchmarking would assist in identifying "pockets of excellence" in maintenance performance throughout the Kodak community. To facilitate the eventual sharing of internal best practices within the company, it was necessary to form a network that included all nine worldwide Kodak manufacturing plants, located in New York, Tennessee, Colorado, Mexico, Brazil, England, France, Australia, and Canada.

A Kodak Park team to coordinate and carry out the benchmarking program had five members, two of whom were facilitators. One acted as a benchmarking process expert, and the other as a technical expert on maintenance operations. The Kodak Park division manager functioned as the project sponsor and process owner. The benchmarking team worked directly with a worldwide team representing each of Kodak's nine plants.

Plant representatives were responsible for coordinating data collection at their plants and communicating the information back to the benchmarking team. At Kodak Park, a second team consisting of 36 department managers facilitated gathering the large volume of data. The managers created and maintained their own department's data, and were ultimately responsible for developing localized improvement programs based on identified performance gaps.

In addition to focusing in on internal Kodak maintenance performance, the team felt that it would be beneficial to benchmark with external corporations as well. This would tell Kodak what industry achievement levels were for the various performance measures, and how Kodak operations compared.

To accomplish this, Kodak enlisted the participation of two large trade organizations. One was the Plant Engineering Maintenance Managers Conference (PEMMC), which consisted of eight large U.S.-based industrial companies. The other was the Society for Maintenance and Reliability Professionals (SMRP), which included 19 corporations. The objective of this external focus was to provide a structured network for information exchange. Many of the partners in PEMMC and SMRP were already known to be best-in-class performers in at least one facet of corporate maintenance (based on a study by A.T. Kearney Research Consultants). Those companies were willing to participate with Kodak in a noncompetitive networking environment. This approach illustrates the value of utilizing trade associations and other industry groups to support benchmarking efforts.

Collecting Information

Because of the many internal participants, the data base became very large and diverse. The benchmarking team found it necessary to group the internal Kodak data into natural maintenance "families" in order to compare similar department's performance. To accomplish this, the team collected information on the type of manufacturing operation the maintenance department primarily supported (process, finishing, other). For example, one such family consisted of process departments with wide roll-type operations (paper or film), such as roll coating, paper manufacturing, and film sensitizing.

To compare operations, the team developed measures for cost, quality, and delivery. It asked all participants in the study to provide information in these three areas via a questionnaire, which had with 30 questions addressing 12 key maintenance performance measures. The measures were selected to represent a balanced scorecard of the maintenance business, and included both leading and lagging measures. A leading measure is one that anticipates an action. For example, predictive maintenance is usually a leading measure of equipment failure. Conversely, a lagging measure is one that results from an action. Typically, inventory costs would be a lagging measure of the amount of spare parts on hand. The measures had to be critical to both maintenance and their manufacturing partners.

A kickoff session with all local (Kodak Park) and worldwide contacts attempted to ensure a common understanding of terms, processes, and data requirements. With a project of such wide scope, it became evident that consistency in communication of terms and definitions would be vital. To address this issue, the team spent significant time clearly defining benchmarking terms and reviewed them with all of the participants. This minimized misinterpretation, which had been a problem with previous programs.

After this was completed, each plant contact was sent a questionnaire package for distribution to managers of plant maintenance departments. Each department manager was responsible for completing the questionnaire with respect to his or her maintenance unit. A contact person appointed for each plant coordinated data collection. Where possible, contacts were directed to a data source within each plant where the information was already being collected. This eliminated duplication of effort in many circumstances and streamlined the data collection process. This was especially helpful with some of the financial data. The completed questionnaire was then sent to Kodak Park for input into a central data base.

Information from PEMMC and SMRP participants came in via a networking conference. Benchmarking questionnaire packages were sent out approximately three months prior to the data gathering conference. Once all participants furnished the information, a third-party consultant analyzed and summarized the data. Ultimately, the summary went to all participating companies for review. Conferences scheduled in late 1992 shared best practices among the participating companies in the areas of improving the percentage of planned work performed and spare parts management.

ANALYZING

Raw data was input into an internal Kodak centralized data base that calculated 12 key performance measures for each worldwide department. From this data base, the team developed a performance measure matrix for each plant, broken down by department level. For each measure, four values were determined:

- Overall average
- Department best value (the best-performing Kodak department)
- Kodak class value (the best-performing Kodak plant)
- Best-of-the-best-value (best overall performer among Kodak and PEMMC/SMRP).

This arrangement allowed Kodak to identify internal pockets of excellence and compare them with external best practices.

In order to compare Kodak data with PEMMC and SMRP data, it was necessary to choose common measures. With focus on driving down costs and reducing the amount of reactive work, 7 key measures were compared: Percent predictive, percent preventive, percent planned, percent reactive, maintenance cost as a percent of product bill, maintenance cost as a percent of estimated replacement value, and inventory turns. These were a subset of the original 12 performance measures, while the remaining 5 measures were used primarily for internal comparisons. For each measure, range plots were generated which identified high, low, and average values for the SMRP, PEMMC, Eastman Kodak (Kodak worldwide) and Kodak Park data. From these plots, Kodak Park could observe where its performance outstripped or fell behind the worldwide community, and thereby focus on determining improvement plans at the Kodak Park site.

In order to compare worldwide Kodak departments, scatter plots examined the relationship of three performance measures (maintenance cost as a percentage of estimated replacement value versus percentage reactive, maintenance cost as a percentage of product bill vs. percentage reactive, and maintenance cost as a percentage of estimated replacement value versus percentage predictive). Scatter plots were used to compare relationships between any two measures, so that a regression analysis could be performed.

As a final method of analysis, M-squared (measures matrix) or "spider" charts were developed for each worldwide plant, displaying 1992 versus 1993 data for the 12 key performance measures. The charts provided a graphical display of all 12 measures simultaneously for a particular plant, normalized against the Kodak Class performer for each measure. From this chart, a plant could determine where improvements had been made from year to year and where the largest performance gaps existed with respect to Kodak Class values. This graphical tool allowed each plant to look at its whole performance instead of focusing on just one particular measure. It also provided for analysis of relationships between performance measures, so that one could predict whether changing one measure would have a positive or negative effect on the others. ***A key concept here is that the whole system needs to be monitored in order to effectively manage improvement.***

Once the data analysis was complete, the benchmarking team began to look at what opportunities for improvement at Kodak Park the data suggested. On the average, Kodak Park was behind Kodak worldwide in the amount of predictive and preventive work it performed, and was achieving about the same level of performance as the PEMMC and SMRP companies. World class performers were identified as Kodak Mexico, with an average of 24.1 percent predictive work, and Kodak Australia, with an average of 46 percent preventive work.

With regard to reactive work, Kodak Park and Kodak worldwide were essentially the same, while SMRP companies performed significantly better. The analysis gave considerable attention to the amount of reactive work at Kodak Park. The scatter plots and regression analysis revealed a general trend: As the amount of reactive worked increased, maintenance costs increased as well. At Kodak Park, a conservative reduction goal in the amount of reactive work would relate to a $10 million savings in total maintenance cost. Therefore, a significant area of opportunity for Kodak Park was to increase the amount of predictive and preventive work, so that the amount of reactive work would be decreased.

In terms of costs, Kodak Park was Kodak Class with respect to maintenance cost as a percent of estimated replacement value, and basically equal with the Kodak worldwide community in terms of maintenance cost as a percent of product bill. Both of these measures were considered to be industry-dependent, so comparing Kodak figures with the PEMMC and SMRP companies required further analysis. Kodak Park compared favorably with world class values in both areas.

With respect to inventory turns, Kodak Park performed at about twice the level of Kodak worldwide; however, it was significantly lagging behind PEMMC companies. PEMMC companies had an average of 2.3 inventory turns, while Kodak Park averaged about 0.9. Conservatively, at Kodak Park, a 10 percent increase in the number of inventory turns would correlate to a $5.5 million savings in maintenance materials. A significant area of opportunity for Kodak Park was to increase the number of inventory turns, which would lower maintenance material inventory costs. Within the Kodak community, Kodak Australia performed as well as some of the PEMMC companies and provided internal best practices sharing.

One of Kodak Park's strengths was maintenance costs as they relate to estimated replacement value. Therefore, it was essential that any improvements in the other areas were implemented in ways that did not degrade this current strength. This is where the use of the spider chart is critical.

ADAPTING

In order to change behaviors and practices that would improve maintenance performance, the benchmarking program was linked with a maintenance excellence assessment. The assessment consisted of 32 questions tied (directly or indirectly) to the 12 key maintenance performance measures. Each Kodak Park department was asked to score its own performance, as well as to have its manufacturing partner score the maintenance department. From the marriage of the maintenance excellence assessment and the benchmarking program, each maintenance department was able to meet with its manufacturing partner to develop a strategy for closing the gaps. Collectively, the individual department plans would drive the overall division performance improvement.

As indicated earlier, one of Kodak Park's opportunities was to increase planned work in order to reduce the amount of reactive work. Via discussions with Kodak Mexico, Kodak Australia, and leading PEMMC companies, the maintenance information system's planning and scheduling function was upgraded. Improvement in the percentage of planned work from 1992 to 1993 at Kodak Park was approximately 6 percent — a significant improvement, with room for further progress.

With regard to inventory turns, Kodak Park made great strides from 1992 to 1993, raising inventory turns by about 15.5 percent (from 0.77 to 0.89). To further increase inventory turns, Kodak Park has initiated a spare parts inventory improvement program based upon learning from Kodak Australia. So far this change has saved $3 million. Other new methods learned have included negotiating 12-month fixed-price contracts and signing agreements with outside suppliers to hold the items in storage until needed by Kodak Park maintenance. This allowed Kodak Park to reduce the unit cost of most items. The 1993 year-end goal was to reach 1.0 inventory turns (additional savings of $5 million), and striving toward world class levels of 1.5 to 3.0 by the end of 1994. As of the date of this report, Kodak is tracking ahead of its plan.

Table B-1 summarizes some of the resource commitments allocated for Kodak's study.

LESSONS LEARNED

Kodak learned much about itself and the benchmarking process as a result of this study. Management support and involvement were critical throughout the entire benchmarking process, as was participant accountability.

Table B-1.
Kodak Resource Allocations by Plan, Collect, Analyze, and Adapt Phase

	Plan	Collect	Analyze	Adapt
Cost of this stage as percentage of total expenses	15	40	15	30
Length of time to complete this stage	3 weeks	3 weeks	4 weeks	ongoing
Number of full-time equivalents involved during this stage	11	11	11	11
Number of people on benchmarking team during this stage	12	12	12	12
Percentage of each team member's time devoted to the study during this stage	25	25	25	25
Consultant used at this stage	Yes, internal	No	No	No
Milestone review used at this stage	Yes	Yes	Yes	Yes

Benchmarking should ideally be aligned or integrated with the strategic planning process; it was extremely important to show that the benchmarking study linked directly with the overall strategic plan of the organization. Otherwise, it would have been viewed as another "program of the month."

Because benchmarking is a continuous learning process and is focused on the long-term success of the organization, Kodak continues to make benchmarking an *annual* process.

APPENDIX C

Case Study No. 2: U.S. Department of Energy, Office of Environmental Restoration and Waste Management: Benchmarking for Cost Improvement Study

Case Study No. 2: U.S. Department of Energy, Office of Environmental Restoration and Waste Management: Benchmarking for Cost Improvement Study

In May 1993, the Department of Energy's (DOE) Office of Environmental Restoration and Waste Management (EM) initiated this study[1] as part of a larger effort to improve programmatic effectiveness and efficiency. The study utilized a multi-faceted approach which included the following methods:

- *Program Classification of EM Activities:* Environmental restoration projects and waste management activities were categorized using distinct criteria. Criteria included waste type, functional activity, project type, project stage, funding distribution, and type of problem. The goal of this analysis was to target future cost improvement opportunities.

- *Nationwide Cost Improvement Survey:* Some 3,300 individuals were asked to provide an opinion on cost estimating practices, resources, regulatory requirements, and programmatic issues. In addition to answering questions, respondents submitted written cost improvement suggestions.

- *Paired Cost Comparison:* The paired cost comparison isolated and compared the cost of similar projects and activities. The comparison identified and explained differences between DOE and non-DOE projects and waste management activities. Projects and activities were selected for comparison from four categories: standard construction, underground storage tank removals, Resource Conservation and Recovery Act (RCRA) closures, and the operation of a hazardous waste storage facility.

- *Component Benchmarking:* The project team decided to study a single high-cost process common to both environmental restoration projects and waste management activities. The process chosen was the monitoring of hazardous materials tanks containing between 1,000 and 25,000 gallons of liquid, sludge, or slurry waste. A benchmarking partner with an analogous process was selected for data comparisons.

The first three methods described are not so much representative of benchmarking as they are exercises in competitive/comparitive analysis. These methods are, however, very valuable and are often used during the planning phase of

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[1] U.S. Department of Energy, Office of Environmental Restoration and Waste Management, *Benchmarking for Cost Improvement,* Final Report, September 1993.

benchmarking studies. The fourth method, *component benchmarking*, fits into the process benchmarking structure outlined in Chapter 1. This becomes readily apparent upon closer examination of DOE's definition of component benchmarking:

> A comprehensive component benchmarking process measures the performance of "best-in-class" organizations, determines how these organizations achieve their performance levels, and uses the information as the basis for measurable self-improvement in performance. . . . The key challenge is to either adopt or adapt the partner's practices in order to achieve this goal and associated performance levels.

One can see that this is essentially "process benchmarking" under another name. For illustrative purposes and the sake of brevity, we focus here only on this final portion of the study examining the actions taken at each of the four major benchmarking study phases (i.e., plan, collect, analyze, and adapt).

PLANNING

During their kickoff meeting, the benchmarking team developed a set of criteria and a listing of all processes that were amenable to a benchmarking study. These are shown in Table C-1.

Table C-1.
Processes Identified as Potential Benchmarking Candidates

Criteria	Processes
Consistent with paired cost comparison	Drilling holes
Data available	Lab analysis of core sampling
Feasible within schedule	Interim storage of hazardous waste
Crosscut environmental restoration	Hazardous waste tank monitoring
Crosscut waste management	Operation of hazardous waste incinerator
Relevant to future	Water/sanitary plant operation
Generalize across complex	Underground storage tank removal
Frequency of practice	Subsurface disposal of low-level wastes
High unit cost	Preparation of work plans
Opportunity for reduction in cost	Characterization process for decontamination
Discrete component	Management cost
High regulatory complexity	Independent closure verification
	Confined entry practices
	Laboratory analysis of volatile organic compounds

The lists were refined with assistance from EM managers at DOE headquarters to determine the most suitable and feasible process to study. It was decided that monitoring of hazardous materials tanks would be the sole focus of the study effort. The universe of tanks addressed by the study included only those holding between 1,000 and 25,000 gallons of liquid/sludge/slurry meeting the EPA/RCRA definition of hazardous material. The goal was to identify practices that could lead to cost improvements in this area.

Study partners were selected on the basis of their existing tank monitoring programs, their appropriateness to the study effort, and the relative availability of data. Additionally, the International Benchmarking Clearinghouse was consulted to help determine who was best-in-class among private industry and to ultimately select the private partner. One non-DOE Federal facility was selected, with the major difference being the nonexistence of nuclear material in their tanks. The project team also visited two DOE sites.[2] This illustrates that an internal and external study need not be mutually exclusive methods.

Collecting Information

The information collected by the team falls into four major categories called "component characteristics:"

- *Tank characteristics:* size, construction, contents, secondary containment, environment and monitoring equipment.
- *Process characteristics:* monitoring, oversight of monitoring process, visual inspection, rain water removal, and safety/training.
- *Regulatory characteristics:* regulators, regulations, regulatory relationship, regulatory change pace, accountability, enforcement, and cost effect of regulatory change.
- *Cost characteristics:* funding, major cost drivers, current cost saving methods, and cost savings.

Data was collected on these particular characteristics because it was thought that they had the greatest overall impact on the cost of a tank monitoring program.

Measuring the magnitude of performance disparity and determining why the disparity exists is the crux of any benchmarking study. The validity of any data measured is critical as well; a measure must actually reflect what it is presumed to assess. Two DOE sites were used to increase data validity in this study. In retrospect, however, team members thought that the two sites should have been treated as separate benchmarks due to the differences between the sites. Another alternative would have been to obtain statistical samples in order to produce a DOE aggregate.

[2] The identity of the partners is not revealed in the report.

To maximize reliability, a previsit survey, a detailed data collection instrument, and a structured interview were used by the benchmarking team. As in most benchmarking studies, it was necessary to rely on the partners to provide accurate data. In this case, the team was unable to confirm the degree of comparability among cost data. Also, tank characteristics varied considerably among the benchmarking participants.

ANALYZING

The selection of "best" performers (in relation to overall program cost) was prohibited by the wide range of characteristics found. However, the benchmarking team concluded that the private industry partner accomplished many elements of tank monitoring that were common to all participants, and did so using the fewest resources at the lowest overall cost. Accordingly, most of the practices associated with superior performance were obtained from the private partner. The study also found that the cost differences between one of the DOE sites and the non-DOE Federal partner were not as great as expected (approximately 50 percent), given the addition of nuclear requirements at the DOE site.

The existence of radioactive materials in the DOE tanks leads to higher costs due to additional requirements and procedures. DOE's efforts to upgrade its aging facilities to current standards is another significant cost factor. DOE's internal rules, standards, orders, and guides also produce differences in procedure and ergo cost. Extensive quality management practices were identified as the primary source of potential cost savings. The private-sector partner demonstrated how such practices had produced significant improvements in cost performance.

The benchmarking study allowed EM to identify many enablers (i.e., the practices — in this case, management practices) which led to the lower program costs faced by the partners. Enablers were categorized as either "direct" (related specifically to tank monitoring) or "supporting" (related to general operations). These enabling practices are described in Table C-2.

ADAPTING

The benchmarking team concluded that many of the above practices could be adapted and applied to its specific needs in order to improve cost performance. The benchmarking project team recommended the adoption of the benchmarking process as a permanent component of the EM program.

At this time however, DOE has not implemented any of the findings from the project. A lack of time was cited as a major reason for this inaction. Also, many of those who would have to implement the findings or participate in future benchmarking studies do not have a clear idea of what benchmarking is in the first place.[3]

Table C-2.
Enablers Identified During Analysis Phase

Direct enablers	Actions
Customer/supplier relationship with analytical lab	Adopt TQM approach for inputs and outputs of testing process
Document consolidation	Develop single documents that satisfy multiple agency reporting requirements
Proactive requirements management	Work with legislators and agency committees during the regulatory development process
New technology deployment	Expend additional funds when necessary to ensure long-term cost-savings, and maintain flexibility in complying with future regulations
Ultrasound technology	Find weak spots in tank walls and supply pipes before failures and leaks occur
Supporting enablers	**Actions**
Contractor incentives	Reward performance improvements in the areas of safety, deadlines, budget, and productivity
Reduction of management layers	Streamlining can succeed by not only reducing costs, but also improving performance
Employee involvement in decision-making	Push decision-making authority to the lowest appropriate level
Continuous process improvement philosophy and implementation	Undertake a continuous process improvement program
Proactive regulator interaction	Work out differences at the start of the compliance process instead of seeking exceptions later
EPA requirement modification	The recent closure of a large number of military bases may lead to streamlining of some clean-up process compliance steps
Capital equipment investment	Design procurement processes to reduce delays in acquiring needed equipment
Reverse appraisal	Give employees a role in the performance appraisal processes for their supervisors
Employee suggestions/incentives programs	Provide continuous opportunity for input by those actually performing the work
Community development	A "Good Neighbor" policy pays dividends when public hearings or special permits are required

Note: TQM = total quality management; EPA = Environmental Protection Agency.

[3] Steve Meador, Department of Energy (telephone conversation, 4 January 1995).

The failure to follow up and implement findings is one of the common mistakes made by companies conducting benchmarking. It also illustrates the fact that benchmarking, like any other process, is only as effective as the people controlling and using it. In this case, the lack of management commitment led to the present stasis. An organization that is not ready to benchmark should not do so.

APPENDIX D

Case Study No. 3: Generalized Benchmarking — The Business Roundtable Facility-Level Pollution Prevention Benchmarking Study

Case Study No. 3: Generalized Benchmarking — The Business Roundtable Facility-Level Pollution Prevention Benchmarking Study

GENERAL

In 1993, the Business Roundtable conducted a facility level pollution prevention benchmarking study[1] in order to identify both the common and unique elements of successful pollution prevention programs (e.g., critical success factors). In addition to offering an excellent example of an external study, the results obtained from this benchmarking effort provide the opportunity to present a comparative analysis of the key elements of the current Army prevention program to the identified critical and essential elements of best-in-class prevention programs within private industry.

Although the Roundtable study focused on manufacturing facilities, we believe the majority of findings can be broadly extrapolated to the Army program with useful results. The most obvious is to identify existing barriers to success (systemic, institutional, and/or programmatic) within the Army program, and to then make appropriate recommendations for how the Army can improve its overall performance.

STUDY METHODOLOGY, CONCEPTION, AND PLANNING

The study team utilized the first six steps of the AT&T nine-step benchmarking process (briefly described in Appendix A). The study team comprised representatives from 10 Roundtable member companies as well as outside participants from AT&T Bell Laboratories' Quality, Engineering, Software, and Technologies consulting group. They conducted the project over nine months, beginning in January 1993.

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[1] Information detailed here is extracted from the *Business Roundtable Facility Level Pollution Prevention Benchmarking Study* report, November 1993.

Preliminary Data Collection

An extensive two-month search identified manufacturing facilities meeting the team's criteria. Resources and techniques used to conduct this search included the following:

- The Toxic Release Inventory data base
- The National Roundtable of State Pollution Prevention Programs
- Global Environmental Management Initiative conference proceedings
- Benchmarking project team member recommendations
- The American Institute of Pollution Prevention
- The President's Council on Environmental Quality
- External environmental professionals
- State chemical associations
- Telephone interviews with individual facilities
- Team brainstorming sessions
- High-level searches of journal articles, newspaper reports, newswires, books, and other sources
- Review of professional conference proceedings and papers.

Criteria for Facility Selection

The Benchmarking Project Team utilized the following five basic criteria for determining the pool of potential facilities from which the best-in-class facilities were selected:

- Facility size must be greater than 500 people, with at least two study facilities in the 2,000 – 10,000 employee range.
- Facilities must use chemicals in their manufacturing process, with a least two facilities being chemical manufacturers.
- Facilities must have demonstrated significant results in reducing waste and/or emissions.

- Complexity of facility waste issues must vary, with at least two facilities having highly diversified waste streams.

- Facilities must be located in the United States.

Best-In-Class Selection

A preliminary research report served to screen the eligible facilities and produce a potential pool of 11 from which the final selections were made. After studying the research report, benchmarking team members voted to select those facilities that would become part of the benchmarking study (i.e., best-in-class). The six facilities so selected belonged to the following companies:

- Proctor & Gamble — Mehoopany, Pa.

- Intel — Aloha, Ore.

- Du Pont — La Porte, Tex.

- Monsanto — Pensacola, Fla.

- 3M — Columbia, Miss.

- Martin Marietta — Waterton, Col.

Best-In-Class Data Collection

Data were collected through a combination of one-day interviews at each facility and completion of a comprehensive questionnaire (copy at Enclosure 1). A minimum of three team members conducted on-site interviews and prepared detailed reports of results after each visit.

Analysis

The reports were subsequently evaluated by all team members and the information summarized in a series of tables. The entire team assembled for a three-day data analysis meeting in July 1993. The team drew comparisons among the facilities surveyed and identified both common and unique elements that lead to their successful pollution prevention programs.

The benchmarking team's analysis resulted in identification of the following critical and essential elements for pollution prevention programs. (Note that the wording has been modified where needed to reflect application to an activity or overall organization, rather than just a single facility.) Generally speaking, organizations and activities with the most successful pollution prevention programs do the following:

1. *Have a clear understanding of pollution prevention direction at all levels.*

    a. Have a definition of pollution prevention.

    b. Have either activity (facility) or organizational (corporate) pollution prevention mission, vision, or policy statements.

2. *Identify their wastes and emissions.*

    a. Have a method for identifying and documenting all wastes and emissions (hazardous and nonhazardous).

3. *Have pollution prevention goals.*

    a. Have activity and/or organizational goals.

    b. Use feedback from activity personnel and other sources to provide input (through environmental leaders) into the goal setting process.

    c. Influence the program through organizational pollution prevention directives.

4. *Utilize a champion, facilitator, or other focal point to lead the program.*

    a. Each activity has a facilitator to champion the prevention process.

    b. Facilitators communicate prevention program achievements across the activities.

    c. Facilitators focus on raising the level of pollution prevention awareness of all employees.

5. *Have the full support of management.*

    a. Activity and/or organizational managers commit requisite resources to support pollution prevention activities.

6. *Integrate pollution prevention into business planning.*

    a. Environmental considerations are part of business case analyses.

    b. Pollution prevention goals are part of the business planning process.

    c. Where possible, prevention is used to proactively address future compliance requirements.

7. *Assign priorities to waste streams.*

8. *Utilize cross-functional teams.*

9. *Sustain the program through cost-effective investment.*

    a. Prevention projects must achieve a rate of return on investment.

    b. Financial and nonfinancial criteria are used to evaluate projects.

    c. Prevention projects that are not cost-effective are identified and only a small percentage are implemented.

10. *Track and communicate program results.*

    a. Progress is measured.

    b. Results toward goals are periodically published.

    c. Results are communicated to key people.

11. *Use quality tools in their pollution prevention programs.*

12. *Assign responsibility and accountability for pollution prevention results.*

    a. Many activities tie waste and emissions accountability to the generating operation.

13. *Understand their corporate culture and pattern their program to that culture.*

14. *Sustain employee motivation through appropriate recognition.*

    a. Early accomplishments are quickly recognized to help establish the prevention program.

    b. Activity- and/or organization-level recognition programs are established.

15. *Use corporate resources to support the program.*

    a. Activities have access to organizational resources to implement prevention programs.

    b. Activities can use resources outside the prevention arena to assist in their programs.

16. *Integrate pollution prevention into the premanufacturing decision-making process.*

    a. Prevention is included in the research, development, and design phases of product or process life cycles.

    b. Activities work with equipment and raw material suppliers, and customers help identify prevention opportunities for products and processes.

17. *Use new technology to achieve significant improvement.*

18. *Increase pollution prevention awareness through effective communication.*

    a. Communication processes are established within and among activities.

ANNEX 1

Questionnaire Utilized During the Facility-Level Pollution Prevention Benchmarking Study

This section provides the questionnaire that the Business Roundtable study used for collecting data from facilities that were selected as best-in-class. The questionnaire is contained in the Business Roundtable's *Facility Level Pollution Prevention Benchmarking Study,* November 1993.

Facility Level Pollution Prevention Benchmarking Questionnaire

General

1 What is your definition of pollution prevention?

2 Do you have a mission or vision statement for pollution prevention?

3 If yes, is it a corporate or facility mission/vision?

4 Please describe your facility culture. (i.e. Quality Driven, Top Support, Team Work, Management Driven)

5 Was your culture well suited for the implementation of your pollution prevention program or did you have to overcome barriers?

6 Would you attribute any change in your culture to the implementation of your pollution prevention program?

7 Is pollution prevention a core value for your company?

8 If yes, how is it reinforced at the employee level?

9 What was the catalyst that started your pollution prevention program? (i.e. regulations, fines, corporate policy) Please describe.

10 What role do federal, state, and local regulations play in developing and executing your pollution prevention program?

11 Are there differences between corporate pollution prevention efforts and facility pollution prevention efforts? If yes, what are they?

12 What benefits do you attribute to the implementation of your pollution prevention program?

13 Do your pollution prevention efforts impact the bottom line? If yes, please explain.

14 Does corporate engineering, marketing, or research/laboratory participate in your pollution prevention program? If yes, how?

Goals

15 What does your pollution prevention program target for reduction? (Please see following table.) For each, please describe corporate/facility goals, use, generation and emissions.

Reduction Target	*Yes/No*	*Corporate Goal*	*Division Goal*	*Facility Goal*
Solid Waste				
Waste Water				
Air Emissions				
Employee Exposures				
Hazardous Waste				
Gaseous Waste				
TRI Chemicals				
Water Use				
Energy				
Other				

16 How are corporate goals set?

17 What are the principles behind the corporate goals (i.e. Are they volume based, efficiency based {pounds waste/pounds product or pounds emissions/pounds product}, worker exposure based, toxicity based, etc.)?

18 How are facility goals set?

19 What are the principles behind the facility goals?

20 Did the public play a role in either corporate or facility goal setting? If yes, please describe.

21 Are your goals aimed at meeting or exceeding current and future regulatory requirements?

22 How often do you publish results against your goals?

23 Who receives the published results?

24 How do you measure the success of your pollution prevention efforts?

25 How instrumental have your pollution prevention goals been to your facility's success?

Facility Organization

26 What is your organizational structure?

27 How many people are in your environmental organization?

28 Where does your facility organization fit into division and/or corporate structures?

29 How does your facility environmental group relate to the corporate EHS structure?

30 How is your pollution prevention program managed and organized (i.e. facility/corporate)?

31 What are the components of your pollution prevention program organization (i.e. councils, task forces, teams, etc.)

32 Who are the members of your councils, task forces, teams, etc.?

33 How much time does each person spend on pollution prevention efforts?

34 How often do the members of your councils, task forces, or teams meet?

35 What is the duration of a council, task force or team (i.e. permanent, 1 year, 6 months)?

36 What other company resources (i.e. R&D, Product Development) aid you in your pollution prevention program?

37 Where are these other resources located in the company?

38 Do you use outside consultants or contractors for the pollution prevention program? If yes, what is their role.

39 Is your pollution prevention program broken down into other components such as energy conservation, incident reduction, product design? Please list the other components.

40 If there are other components, do they fall within the pollution prevention program organization or are they separate?

41 What organizational barriers were/are there and how were they overcome?

Pollution Prevention Program

42 Please describe the basic elements of your facility pollution prevention program or process.

43 What do you believe are the key elements necessary for a successful facility level pollution prevention program?

44 What are your pollution prevention program drivers?

45 How did you develop your program?

46 How did you introduce the program to your work force (i.e. roll out strategy)?

47 What is the relationship between your pollution prevention program and quality?

48 Do you use quality tools as a part of your pollution prevention program (i.e. SPC, Pareto, etc.)? If yes, which ones and how?

49 Where in the product life cycle are pollution prevention concerns addressed (i.e. Research, Design, Development, Manufacturing, Marketing, Disposal)?

50 What were the major obstacles in developing or implementing your pollution prevention program?

51 How did you overcome those obstacles?

52 Which of the following pollution prevention techniques do you use? Please estimate how heavily each technique is used in your program. (High, Medium, Low).

Technique	*Usage (H,M,L)*	*How often does the technique meet return on investment? (Never, Sometimes, Always)*
Housekeeping		
Product Change		
Process Change		
Equipment modification		
Raw Materials Change		
Recycling		
Reuse		
Inventory Control		
Converting and Marketing By-Products		
Other		

53 Do you track the return on investment for each of these initiatives?

54 How does your facility divide resources between pollution prevention initiatives/projects and compliance initiatives/projects?

55 Is compliance your facility's primary focus with pollution prevention as an add-on, or is pollution prevention the primary way of achieving compliance, or are they completely separate?

56 Have you ever decided not to accept products or projects into your plant because of environmental, health, or safety implications?

57 What programs have you tried that didn't work and to what do you attribute their failure?

Pollution Prevention Funding

58 How do pollution prevention projects at your facility compete with other capital improvement projects?

59 What financial criteria is used in evaluating the acceptability of a pollution prevention project?

60 What do you include in your cost analysis?

61 In calculating the costs of projects, do you try to calculate long term costs of pollution?

62 Where does pollution prevention project funding come from (product funding, corporate, pollution prevention account, etc.)?

63 What percentage of environmental spending at your facility is on:
- compliance,
- pollution prevention projects?

64 Which projects do you believe are the most cost effective – compliance or pollution prevention? Why?

65 How do you determine costs and cost effectiveness?

66 Is a rate of return needed to approve an environmental project? If yes, what is it?

67 How are environmental costs calculated?

68 Are they allocated (realized) back to processes or are they charged to overhead?

69 Are indirect or non-tangible costs included in pollution prevention project analysis (i.e. future liability, company image, etc.)? If yes, how are they quantified?

70 What non-financial criteria is used in evaluating pollution prevention projects (e.g. community advisory panels, regulations, etc.)?

71 Are all pollution prevention projects cost effective? If not, what percentage are?

72 Have you implemented pollution prevention projects that were not cost effective? If yes, please describe the circumstances.

73 Were there pollution prevention projects you could have implemented but did not because they were not cost effective?

Business Planning

74 Are facility pollution prevention goals a part of the business planning process? If yes, please describe.

75 Are environmental considerations a part of business case analysis? If yes, please describe.

76 What business barriers are/were there to implementing pollution prevention projects?

77 How are these barriers overcome (i.e. customer/product specifications, etc.)?

Training

78 Please describe your pollution prevention training process. Please include information about awareness training, new employee training, and process training.

79 Who is required to receive pollution prevention training?

80 Is pollution prevention training integrated into other training (i.e. process engineering, TQM, etc.)?

81 Did you use employee training programs or management briefings as part of your roll-out strategy?

82 Do you use employee training as part of the sustainment of your pollution prevention program?

83 How many hours do people spend in pollution prevention training? What is the balance between regulatory training and facility initiated training?

84 How much money does the facility invest in pollution prevention training?

85 How did you develop pollution prevention training?

86 Do you share training modules amongst facilities?

Technology Transfer

87 How do you find and evaluate new technology or pollution prevention ideas?

88 What are your sources of information for new technology? (Internal technology transfer, external technology transfer, etc.)

89 Please describe your technology transfer process (facility to facility transfer, corporate to facility transfer, external to the corporation (university, industry), etc.).

90 What unique or innovative approach or technology have you used to produce significant results?

91 How do you evaluate new technologies and lessons learned across processes?

92 How are new technologies and lessons learned incorporated into your program?

93 Are the gains you've experienced incremental or step changes or a combination or both? Please explain.

94 What could be done to enhance technology transfer in the future?

Corporate Role

95 What corporate resources are available to help you with the deployment or maintenance of your pollution prevention initiatives?

96 What has your corporate environmental group done to help you achieve your goals?

97 Which corporate pollution prevention directives influence pollution prevention program development and implementation at the plant level (i.e. goals)?

98 Do you ever feel that the corporate environmental group hinders your pollution prevention program? If yes, how?

99 Do you have any recommendations about what a corporate environmental group should avoid doing?

100 What could your corporate group do to add value to the pollution prevention process?

Inventory

101 Do you have a method for identifying and documenting all hazardous and non-hazardous waste and emission streams? If yes, please describe.

102 Do you track waste and emissions by product stream, individual waste or both?

103 What types of waste and materials do you track (i.e. hazardous, non-hazardous, municipal solid waste, used oil, energy, etc.)?

104 Do you have fugitive emissions? If yes, are they accounted for?

105 What type of tracking system do you use (PC based, paper intensive, mainframe based)?

106 Who does the tracking (i.e. pollution prevention person, staff, etc.)?

107 If you use a computer software tracking system, is it off-the-shelf or customized for your company? Was it developed within your company?

108 Do you work with raw material and equipment suppliers to reduce waste?

109 Can chemicals be returned to chemical suppliers?

110 How often do you update your inventories?

Prioritization

111 What criteria do you use to prioritize waste streams and emissions (i.e. future liability, regulatory requirements, toxicity, volume, cost of disposal, etc.)?

112 Do you use consistent or standard criteria to prioritize waste or waste streams? If yes, what are they?

113 How are priorities set on which pollution prevention projects to implement?

114 For achieving near term compliance, how do you evaluate pollution prevention and end-of-pipe alternatives?

115 How far ahead do you look at compliance requirements.

116 How large a part does pollution prevention play in meeting those requirements?

Metrics

117 What performance measurements do you use to track your progress?

118 What data do you collect to support these measurements?

119 Is the system you use to collect data or performance measurements corporate or facility based?

120 What data systems or tools do you use to track your progress?

121 Do you have a process or method for benchmarking of like industries?

122 How do you measure the success of your pollution prevention program efforts? What is your index or unit of measurement?

123 Is your index or unit of measurement used to prioritize projects? If yes, how?

124 Are your facility metrics compared to other facilities in your company?

Roles, Responsibilities, and Accountability

125 Using the listed terms, please indicate the primary role of each of the following people with respect to your pollution prevention efforts (leader, facilitator, idea generator, customer contact, problem identifier, communicator, technical input, Implementor):

	Role/Responsibility
Environmental Professional	
Project Engineers	
Manufacturing Personnel	
Plant Manager	
Maintenance Personnel	
Transportation Personnel	
Treatment Storage and Disposal Personnel	
Plant Technical People	
Contractors	
Business Unit Manager	
Middle Management	
Media Relations	
All Plant Personnel	
Other	

126 Who is ultimately responsible for developing and implementing pollution prevention projects at your facility?

127 How do you network resources for pollution prevention initiatives?

128 Who is responsible for pollution prevention results?

129 Who is accountable for pollution prevention results?

130 Do the job descriptions at your facility include responsibility for pollution prevention? If yes, please describe.

131 How are responsibilities and consequences of waste generation tied to responsible levels, down to the waste generator?

132 Is pollution prevention a part of the performance review and compensation process? If yes, for what levels? Please describe.

133 Who is responsible for following up on pollution prevention projects after they have been implemented (i.e. data collection, documentation)?

134 What actions are they empowered to take?

135 Is doing a good job in pollution prevention perceived to impact an employee's career?

136 What part of the management structure offers the greatest resistance to pollution prevention?

137 How did you or how do you get these member of management involved?

138 What were their concerns?

Recognition and Reward

139 How are employees and or teams recognized at the plant level for pollution prevention accomplishments?

140 How are employees and or teams recognized at the corporate level for pollution prevention accomplishments?

141 Who presents corporate/facility level awards?

142 What do you think is the key factor in motivating your employees?

143 How do you sustain employee motivation?

Communication Internal

144 How do you communicate information to employees within a facility?

145 How do you communicate information to employees between facilities?

146 How do you maintain momentum for internal communications?

147 How do you share/communicate success stories?

148 Do you share "lessons learned"?

149 Are there any other communication techniques?

Communication External

150 Do you communicate with neighboring communities about your pollution prevention efforts? If yes, please describe.

151 Are facility pollution prevention initiatives an important contribution to the local public image of the company? If yes, how do you assess this?

152 How do you communicate with the media and/or activist groups?

Public Involvement

153 Do you utilize university resources or students in your pollution prevention program? If yes, how?

154 What role does the local community play in your plant pollution prevention work?

155 What role does the facility play in the community's pollution prevention efforts?

156 Do you utilize community organizations in the implementation of your program? If yes, which ones and how?

157 Do you work with other industries to help them improve their pollution prevention programs?

Future Direction

158 If you had it all to do over again, what would you have done differently?

159 What is your vision for your facility's pollution prevention efforts in the future (Vision 2000)?

160 Where do you think the industry is going with pollution prevention in the future?